THE FILTRATION OF PUBLIC WATER SUPPLIES IN AMERICA.*

BY J. J. R. CROES, M. AM. SOC. C. E., M. INST. C. E.

The subject assigned to the writer is the methods of filtration of water in use in the United States and Europe, with details of construction, cost and efficiency.

The term "filtration" is used to denote the process of purification of water by passing it through a layer of material of some kind artificially prepared.

It is distinguished from "natural filtration" in which the underground water is understood to pass through porous strata of the earth in its natural state, and be collected in galleries or wells.

The discussion of natural filtration has been assigned as the subject of another paper for this meeting. It was also treated in some detail in a paper recently read by the writer before the American Society of Civil Engineers.

The object of filtration is to remove the visible impurities of water and render it colorless. With the removal of the matters which cloud the water there is also to a limited extent a lessening of the chemical impurity, but the general result is more mechanical than chemical, and it is believed to be well established that processes of filtration which are capable of being applied on a large scale do not make a polluted water fit for domestic use.

The attempts which have been made in this direction have not been successful.

The principle of filtration is that by the slow passage of water through very small orifices the matters held in suspension are deposited on these orifices.

If the water is passed through rapidly or under great pressure the filtration is imperfect, the sides of the orifices being washed clean and the grosser particles not having an opportunity to settle.

As long as this principle is borne in mind the operation of filters is easy to understand and their construction is free from difficulty. The failure of the many filters which have proved unsuccessful may be almost always traced to ignorance or forgetfulness of this principle, and the setting up of some false theory in its place.

In Europe, particularly in England, the supply for a considerable number of towns is filtered before using.

The plan of the works is generally the same. The water when very turbid is first allowed to settle, and is then allowed to flow over a bed of fine sand, which overlies coarser sand, gravel and broken stone in layers of gradually increasing coarseness, beneath which drains are provided to carry the filtered water to the distributing basin. It is ordinarily the first few inches of sand on the top which do the actual work of purification. The lower coarse materials only prevent the sand from being washed away.

As the interstices of the top sand become clogged the head of water must be increased and finally the water drawn off and the top layer of sand removed. This can be cleaned and replaced.

The rate of percolation which seems to insure good results is from 1,000 to 2,000 gallons per day for each square foot of filtering area, according to local circumstances and turpidity of the water. It is not safe to assume that a sand filter bed will at all times yield more than 1,000 gallons per day per square foot.

The carrying out of this system of filtration in a thorough manner is necessarily somewhat expensive.

The work must be carefully executed and the maintenance must be systematically attended to. The expense attending it has probably been the reason why it has not been adopted to any great extent in America.

Several plans involving more or less incomplete filtration, or more properly straining of water, have been devised and used with varying success in this country. The reports and returns received with reference to these are so deficient in the details furnished as to make a comparison of costs and efficiency impossible.

The only place in which an accurate account of the expenses attending the filtration is reported is Poughkeepsie, New York.

These works and those at Hudson, New York, were built on the general plan of the English filters, and both were constructed by J. G. B. Rand, C. E.

The Poughkeepsie works were planned by Mr. Kirkwood.

The water is pumped from the Hudson River into a settling basin 25 by 60 ft. and 12 ft. deep, arranged in three compartments.

From these it passes to the filter beds, two in number, each 200 by 73.5 ft., giving a superficial area of 29,400 sq. ft., and 12 ft. deep, 6 ft. of which is occupied by graded gravel and sand resting on a concrete floor. On the floor are open stone culverts, which lead the filter water away to the reservoir.

These beds cost $54,000.

The report of Charles E. Fowler, C. E., the superintendent of the water-works, gives the cost of operating the works for the year 1882 as follows:

Number of gallons filtered	508,304,780
Cost of cleaning beds 13 times	$327.25
Cost of washing sand	920.69
Cost of repairs	14.62
Total	$1,271.56
Cost per million gallons	2.50

The Hudson filter bed has an area of 9,081 sq. ft. It is 13.5 ft. deep, 6 ft. of which is occupied by graded gravel and sand.

There were filtered during the year ending September 30, 1852, 390,028,160 gallons, which the Water Commissioners state "taxed the filter to its utmost capacity."

From these figures, the rate of filtration appears to be 1,177 gallons per square foot of surface per day at Hudson, and only 50 gallons per square foot at Poughkeepsie.

The cost of cleaning and washing at Hudson is given in the report of Mr. John S. Ray, the superintendent, as $235.82 for 1882 or only 60.5 cents per million gallons filtered.

Part of the difference of cost may be accounted for by the fact that at Hudson the sand is washed by a machine designed by Mr. Ray, which is said to facilitate the cleaning very much, but this cannot account for the fact that the cleaning of the filter beds alone in Poughkeepsie apparently cost more per million gallons than the whole care of the Hudson filters did.

The washing machine consists of a cylinder 30 in. in diameter and 7 ft. long, with a worm in it. The sand is thrown into one end of the cylinder into which water is pumped by a small steam pump, the engine of which also revolves the cylinder.

The sand passes from the cylinder into a box in which is another worm. Passing through this box it is received in a box from which an elevator raises it 7 ft., discharging it into wheelbarrows.

The other filtering arrangements which have been used in this country are as follows, as far as the writer has been able to ascertain. In many instances the information furnished has been very meagre, the superintendents of the works evidently not appreciating the necessity for exactness in figures and fullness of detail.

It has not been possible to obtain the cost of any of them.

The first recorded attempt to filter a public water supply in the United States was in 1831 at Richmond, Virginia, where a gravel filter bed was attached to each division of the reservoir.

The James River water is highly charged with a red clay in suspension, which settles very slowly. Samples of the water left undisturbed for three months retain a decided color.

The filters were designed by Mr. Albert Stein, one of the earliest water-works engineers in this country and a man distinguished in his day. The first filter was 22.5 ft. long and 16 ft. wide, and the "process of filtering was effected by the water ascending upward from the bottom and the sediment was washed away by discharging water downward from the top." This not having had much effect in purifying the water, a second was constructed to filter downward.

This too proved ineffective and their use was abandoned, and for 50 years the water supplied to the city has been most of the time very muddy, the reservoir capacity being too small to allow time for partial purification by deposition.

Upward filtration was next adopted at New Milford, Connecticut, in 1874, by W. B Stilson. A brick chamber was built in the storage reservoir and filled with gravel sand and charcoal through which the water passes upward. The amount is not known, nor are the dimensions of the filter given.

An upward filter was next constructed at St. Johnsbury, Vermont, in 1876, by J. P. Flanders. The water of the Passumpsic River is passed up through four feet of gravel. The area of filter is not known. The filter passes satisfactorily 250,000 gallons per day.

In 1877 T. N. Boutelle constructed a filter with upward flow at Burlington, Iowa.

It is 130 ft. by 20 ft., with 3 by 4 in. slats, on which are 3.5 ft. of graded gravel and sand. This will filter 300,000 gallons per day, but at the rate of 400,000 gallons the water is muddy.

In 1877 a filter basin was constructed at Marshalltown, Iowa, of masonry 32 by 16 ft. The floor of two-inch plank supported on joists is perforated with three-fourths inch holes and covered with wire gauze. On this is charcoal 4 in. thick, and above this 14 in. of clean sand and gravel.

In 1878 W. C. Stripe constructed at Keokuk, Iowa, a filter 50 by 15 ft., of brick. Timber joists laid on edge, a quarter of an inch apart, support 2.5 ft. of gravel, charcoal and sand, through which about 600,000 gallons of water pass upward daily.

In 1878, at Lewiston, Maine, M. M. Tidd constructed a gravel filter of 400 square ft. area and 32 in. deep, in the conduit leading from a pond to the pump well, the water passing upward through the gravel. The consumption is 1,000,000 gallons.

In 1879, an upward filter was constructed at Golden, Colorado. It is 5 by 9 ft. and the gravel is 2.5 ft. thick. The bottom is of 1 inch boards, 4 inches wide, placed on edge half an inch apart. This filters 10,000 gallons per day.

In 1880, at Stillwater, Minnesota, W. H. Sears constructed an upward filter 100 by 50 ft. and 10 ft. deep, of gravel and charcoal. The supporting joists are strips of 2 in. lumber, 4 in. high, set on edge. The consumption is 1,210,000 gallons.

The second attempt to secure filtered water seems to have been made at Kingston, Ontario, in 1849 by R. L. Innes.

A wooden crib divided into compartments and filled with coarse stone gravel and sand is submerged in Lake Ontario. The suction pipe to the pumps leads from the bottom of the crib.

The dimensions of the crib are not furnished. The supply is 750,000 gallons per day.

The filter is reported as being capable of passing 3,000,000 gallons daily.

This plan has been adopted in a number of places with very varying results.

In 1870, at Columbus, Ind., a wooden box 5 ft. square was sunk in the Driftwood River and covered with sand and gravel. For 100 ft. from the pump-well it is tight, for 300 ft. further it is perforated on the bottom only with 1.5 in. holes, and it terminates with a section 12 ft. long, perforated on the sides and bottom and filled with gravel. The daily draught of water is unknown, but the filter works successfully.

In 1871, at Decatur, Ill., a crib 600 ft. long and 10 ft. wide and 6 ft. high was sunk in the bed of the Sangamon River and arched over, which furnishes 250,000 gallons daily. At Terre Haute, Ind., a filter was made of gravel in cribs, which is submerged 25 ft. at high water and has not proved successful in clarifying the water, but is used to comply with the condition of the company's charter which requires the water to be "filtered."

Similar cribs or boxes sunk in the bed of a stream and filled with gravel have been built at East Saginaw, Michigan; at Evanston, Illinois, where the filter 125 ft. long silted up and became useless, at Indianopolis, Ind., where a similar crib became choked and then broke in under heavy draught in the suction pipe and filled the pipe and pumps with sand and gravel: Muscatine, Iowa; Memphis, Tennessee; Las Vegas, New Mexico; and Parkdale and Brampton, Ontario. In 1882 a filter was built at Longmont, Colorado, under the river, 2 ft. wide and 1 ft. high, covered by 2 ft. of gravel.

These filters cannot be relied upon to furnish clear water when the stream is very muddy, nor when the draught through them is rapid.

The first attempt at filtration through layers of sand and charcoal was made at Elizabeth, New Jersey, in 1852. This filter is said to have 1,000 cubic feet capacity but its construction, superficial area and efficiency are not reported. The water is procured from a small stream which is ordinarily quite clear.

A somewnat similar arrangement was constructed in 1857 for Malone, N. Y. When the springs which ordinarily supply the town are low, a supplementary supply is obtained from the Salmon River, the water of which is passed through a filter of sand, gravel and charcoal.

In 1868, the University of Virginia built works after plans of George Peyton, C. E. The water of an impounding reservoir passes into a chamber through double brick walls, 15 inches apart, the intervening space filled with charcoal.

In the same year, at Great Barrington, Mass., a filter of gravel and charcoal was made at the outlet of the storage reservoir.

Since 1874, chambers containing gravel and charcoal have been constructed at Tioga, Pa.; Athol, Mass.; Richmond Furnace, Mass.; Hornellsville, New York; Peterborough, Ont., and Cheshire, Mass.

A gravel and sand filter, at the outlet of a storage reservoir on a small mountain stream was built in 1860 at Stockbridge, Mass.

The same kind of filter was built at Scranton, Pa., in 1871; Lenox, Mass., in 1875; Tarrytown, N. Y., in 1877; Elyria, Ohio, and Owego, N. Y., in 1879. These pass from 200,000 to 850,000 gallons per day.

In Carthage, Mo., in 1882, John M. Slaney built a filter of gravel and stone, 25 by 50 ft. and 12 ft. deep, which filters 150,000 gallons a day.

In 1866, at Middletown, Conn., a filter was constructed at the outlet of the impounding reservoir by G. H. Bishop, C. E., by building a double wall of brick filled in with gravel.

There is no means of removing and cleaning this gravel, and it is stated that in hot weather the water which passes through the filter is worse than that which has not. It is probable that this is owing to exposure of the filtered water to the sun and air. There is good ground for the belief

*Read before the American Water-Works Association at Buffalo, May 15, 1883.

that filtered water should not be exposed in uncovered reservoirs, but that it must be kept dark and cool to prevent its rapidly becoming offensive.

In the same year, 1866, the reservoir at Annapolis, Md. (W. R. Hutton, C. E.), was constructed, the effluent water from which is filtered by being passed through three feet of gravel and sand into a brick trough built through the bottom of the reservoir.

The trough is covered with wooden slats, half an inch apart, and the coarser gravel laid on them and then the finer materials.

The water is collected from several springs and is not highly charged with sediment.

In 1872, at Delhi, N. Y., the filter was made by a gravel embankment paved with stone, over a pipe through the bottom of the storage reservoir.

In 1880 Phinehas Ball, C. E., constructed the reservoir at Brockton, Mass., with the view of making the bottom the filtering area; 55,000 square ft. of the surface was underlaid with 4-in. tile drains 8 ft. apart and 30 in. below the surface. These drains led to a rubble conduit 3.5 ft. wide and 4 ft. high, and 745 ft. long, leading to the effluent gate house. This was covered with 4 ft. of earth. The water is intended to leach through the bottom of the reservoir and be carred off by the drains and conduits.

In 1870 a filter was constructed at Norwalk, Ohio, in which the water passed horizontally through gravel, but it proved ineffective owing to too small area of the filtering material.

This horizontal filtration through walls of gravel was used in 1872 at Lebanon, Pa., by H. P. M. Birkinbine. The water passes through a gravel "catch dam," above the main dam of the reservoir, before entering the pipes.

In 1874 Galen W. Pearsons, C. E., constructed a basin for partial filtration through stone and gravel, at Kansas City, Missouri.

Two basins are placed side by side, each 350 ft. long and 100 ft. wide. The water entering the end of one, through a crib filled with stone and gravel, four feet thick, passes at the other end into the second basin, and out the other end of that into the pump well, through a gravel bulkhead. The water is clarified by settling, rather than filtered. Up to a draught of two million gallons a day, this arrangement worked fairly well in getting rid of the grosser matters suspended in the Missouri River water. When the consumption became greater it was necessary to enlarge the capacity of the basins. The basins are 13 ft. deep and hold about 7,000,000 gallons.

Similar works are now constructing at Leavenworth, Kansas.

At Meadville, Pa., in 1875, Robert Cartwright built a filter by excavating a trench 35 ft. wide and 5 ft. deep, 24 ft. long, between the river and a well and filling it with clean gravel. The gravel has to be changed about every four years. The consumption is 400,000 gallons daily.

A similar horizontal filter bank at Three Rivers, Quebec, is 9 ft. thick. It was built in 1875. The daily consumption is 150,000 gallons.

The first American filters in which the methods proved by experience in other countries to be efficacious were followed were those at Poughkeepsie, constructed also in 1870, and which have already been described. They were followed in 1874 by those at Hudson.

At Columbus, Ohio, a filter was built in 1871 and used for several years with reasonably good success. The water of the Olentango River is taken from a pool formed by a dam, which acts to some extent as a settling basin, and is then admitted to a filter bed of 8,742 square feet area of sand seven inches thick, overlying 47 inches of gravel and broken stone. With 30 inches of water over the sand, the bed when clean would filter 500,000 gallons a day. The cleaning was effected by removing and washing the top sand.

The consumption has for several years exceeded the capacity of this filter, and the supply is taken from a natural infiltration gallery.

The construction of similar filters was begun at Toledo, Ohio, in 1879, but the necessary precautions do not appear to have been taken to secure a settlement of the water before letting it on the filter beds, and the experiment was abandoned without having given the system a fair trial in the manner which the experience of European towns has shown to be essential.

An arrangement devised by Phinehas Ball, C. E., was constructed at Springfield, Mass., in 1873, and used for a year or two. A basin of four acres area was made below the storage reservoir dam, by building a small stone wall, in which was left an opening 100 ft. long, in which was placed oak boxes in double rows, each box being 14 in. thick and filled with wood excelsior through which the water passed. The boxes could be lifted out by a derrick on a bridge over the space and the material renewed when necessary. This was soon abandoned as insufficient.

At Clinton, Iowa, in 1874, W. C. Weir constructed a filter in which the sand and gravel are arranged in 16 boxes which can be lifted out and cleaned.

In 1875, in Truro, Nova Scotia, the water was filtered through brush and gravel, with tolerable efficacy.

In 1875, W. B. Rider constructed a filter at South Norwalk, Conn. The water from the reservoir passes through a chamber 3 by 10 ft. and 18 ft. deep, divided into three compartments, separated by wire screens. The first, filled with charcoal, is 6 ft. thick, and the second, 16 in. thick, is filled with sponge, and in the third is the clear water. Similar chambers containing sponge and charcoal in compartments separated by wire screens are used at Bethel, Conn.; Torrington, Conn.; Hornellsville, Walton and Oneonta, N. Y., and Thomaston, Conn.

In 1880, T. N. Boutelle constructed a filter at Hannibal, Mo., in which the water is passed through 3 ft. of sponge and 2 ft. of sand, gravel and charcoal. This will pass 300,000 gallons per day effectually.

At Ottumwa, Ia., a brick filter 20 by 22 ft., containing several screens of animal charcoal, built in 1878, is said to be able to filter 3,000,000 gallons daily.

Charcoal is used at Greenwich, Conn.

At Norwich, N. Y., an arrangement of drain pipe was constructed in 1881 to filter the water. The details of this, designed by P. H. Baerman, C. E., have not been obtained.

Many efforts have been made, in both Europe and America, to perfect mechanical contrivances for cleaning or renewing the filtering materials which have become charged with impurities and clogged. Some of the latest of these machines appear to have been quite successful in effecting quite rapid filtration in consequence of the facility with which the soiled material can be removed. The Newark Filtering Company, of Newark, N. J., constructs a filter which consists of a cylinder within which is a perforated vessel containing sand. The water introduced under pressure into the bottom of this inner chamber passes through the sand and out through the perforations into the annular space between the chamber and the outer cylinder and is drawn off from the bottom of the cylinder. The sand when foul is washed by an ingenious arrangement of pipes and valves which cause it and the washing water to pass over into another cylinder and back again, the wash-water flowing off at the top with the mud in suspension. It is claimed that a cylinder 10 ft. in diameter, holding 750 bushels of sand will filter at least 30,000 gallons of water an hour, and that one per cent. of the amount filtered will suffice to keep the sand washed clean. The system has not been put into practical use on a large scale anywhere yet.

The high-pressure filter made by Joseph Halliday, of Manchester, England, is a cylinder of plate-iron, 8 ft. in diameter, in which are placed layers of charcoal of graduated sizes, on perforated plates. The thickness of the layers is about 4 ft.

The water to be filtered is introduced at the bottom and passes upward through the charcoal. These filters are used in duplicate, and one set of the size named requires eleven tons of charcoal.

This requires renewing every three months, where sewage is filtered after being settled. The larger charcoal can be washed and used again, but the finer must be renewed, requiring about five tons every three months. Ordinarily the filter is cleaned when it becomes clogged by reversing the current and passing clean water downwards. One set of two tanks will filter 80,000 gallons per hour, it is stated.

The Thames filter is made by the Pulsometer Engineering Co., of London. It consists of a cast-iron cylinder, fitted with a piston formed of a circular grating covered with wire gauze. Under the cover of the cylinder is a chamber with a perforated bottom.

The filtering material is sponge, which is placed over the piston, and then compressed by raising the piston.

The water is introduced below the piston and passes upward to the chamber under the cover and is drawn off by a pipe.

To clean the filter, clean water is allowed to flow back through the sponge, the piston being worked up and down at the same time, alternately compressing the sponge and letting it expand and fill with water, in the same way that one cleans a sponge by hand. This filter is made in various sizes, the largest being capable of filtering 4,000 gallons per hour. It is said to be used with success in England and the British Colonies, mainly for supplying pure water to the boilers of large manufacturing establishments.

The Piefke filter, so called after its inventor, the Chief Engineer of the Berlin Water-Works, is used in several large industrial establishments in Europe. A plant of 36 machines is used at a bleaching establishment near Warsaw, which uses 800,000 gallons of filtered water daily. The machine consists of a plate iron cylinder, in which is placed a pile of conical cast iron pots with perforated bottoms and a round hole through the top and bottom, except the top of the uppermost one. It will be seen that water introduced through the bottom of the cylinder at the centre will pass up through the middle, downward through the perforated bottoms of the pots, and up through the annular space around the pots. The filtering material is chemically prepared cellulose, or vegetable fibre, which is mixed with water to a thin paste and introduced through a funnel on the inlet pipe, which is carried up from the bottom to above the top of the filter. This paste distributes itself over the perforated plates, and the filter is ready for action. A filter capable of purifying 1,000 gallons per hour takes 3 pounds of fibre, which is worth about $20 per cwt.

With a head of water on the filter of 3 to 4 ft. the coating of fibre arrests the impurities in the water passed through it.

After 1,200 gallons per square foot of filtering area have passed through, the material needs washing. This is done by revolving a central shaft, which carries arms which stir up the fibre and the collected sediment is washed out. This carries with it about ten per cent. of the fibre, and that proportion should be introduced anew after a cleaning. To clean a filter requires one man for ten minutes. When the arms stop revolving the fibre settles again and the filtering goes on. In practice, a number of filters are grouped around a tank, into which the filtered water is discharged. At the bleachery above mentioned there are three tanks, around each of which are twelve filters, each yieiding 1,100 gallons an hour.

The Farquhar-Oldham filter, also an English machine, but manufactured as well in this country, uses fine sawdust as the filtering medium, and wastes none of the filtered water. The sawdust, either in its natural state or carbonized, if thought necessary, is held in a cast iron cylinder, on a perforated plate. The cover of the cylinder is bolted down. Through a stuffing-box in the cover a hollow shaft passes, which has on its lower extremity a plate in which is a slot extending from the circumference to the centre with a cutting edge. The shaft is made to revolve and to raise and lower by gearing. The liquid to be filtered is introduced through the shaft under pressure, and is distributed over the surface of the filtering material under the plate, and passes out below. The impurities are arrested by the upper stratum of sawdust, and as that becomes clogged, it is shaved off by revolving the cutter-plate, and is deposited on top of the plate. When the depth of the filtering material is reduced to a few inches, the filter is stopped, the shaft reversed until the material collected on the plate is compressed against the top in a solid cake, when the cover is removed and the material taken out and replaced by fresh sawdust.

These filters are made of all sizes and capacities. Their use, in this country at least, has so far been limited to purifying the waste of breweries and manufactories for use in steam boilers and to filtering sewage.

There is hardly as yet sufficient evidence to warrant an engineer in recommending any of these high pressure filters for use in domestic water supply, but the experience had with them is such as to encourage the hope that the day is not far distant when filtered water can be had on a large scale for a moderate outlay.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 274.)

DXXXVIII.—MIDLAND CITY, MICH.

Midland City, Michigan, in lat. 43° 38' N, long. 84° 20' W., is on high ground on the banks of the Tittebawasee and Chippewa rivers.

Settled in 1855, it was incorporated a city in 1868.

Water-works were built by the city in 1882 after plans of M. Walker, taking the supply from the Chippewa River and pumping directly into the mains by two Walker steam pumps of 40,000 gallons daily capacity, with a Perkins compressor on the main. The ordinary pressure maintained is 50 lbs. and fire pressure 100 lbs.

Distribution is by 4 miles of Wyckoff wood pipe of 8 to 4 in. diameter, with 32 fire hydrants, 25 gates and 50 taps. The works have just gone into operation.

Service pipes are of wood, iron and lead.

The population in 1880 was 1,529.

The daily consumption is not fairly established yet.

The works cost $21,000. The bonded debt is $20,000 at 5 per cent. interest.

The works are managed by a Board of Commissioners appointed by the Village Board.

Samuel Foster is President, and William Reardus Secretary.

DXL.—OSKALOOSA, IA.

Oskaloosa, Iowa, in lat. 41.19 N., long. 92° 40' W., is on high rolling land between the Des Moines and Skunk rivers.

Settled in 1842, is was incorporated about 1843.

Water-works were built in 1880 by a private company after plans of Truman Cowell, taking the sup-

ply from Skunk river, 4 miles from the town. A pit is excavated in the rocky bed of the river and a floor of timber laid 3 feet above its bottom, on which floor are layers of gravel, sand, charcoal and sand, through which the water is filtered downward and pumped thence directly through the mains by a Holly steam pump of 10 in. diameter and 18 in. stroke. The town lies 150 ft. above the river, and an ordinary pressure of 80 lbs. is maintained, with fire pressure of 80 to 250 lbs.

Distribution is by 9 miles of cast iron pipe of 12 to 4 in. diameter, with 49 fire hydrants, 8 gates and 184 taps. There are 4 meters in use. The town pays $4,450 per year for fire protection. Service pipes are of plain iron, galvanized iron and lead.

The population in 1880 was 4,598. The daily consumption is not known.

The capital stock of the company is $150,000. The works have cost $102,000. No further financial statistics are given.

William Loughridge is President and D. W. Hunt, Secretary and Superintendent.

ENGINEERING SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

ROOMS, NO. 1523 CHESTNUT STREET.
PHILADELPHIA, PA.

Record of Regular Meeting, June 2, 1883.

Mr Washington Jones in the chair; 15 members and one visitor present.

Mr. Carl Hering read a short article on electrical units and formulæ, giving a list of the units and the relations existing between them; showing how these relations can be combined into formulæ containing any two or more of the units, for convenience of calculations. The units are: *ampère*, the unit of current strength: the *volt*, the unit of electro-motive force; the *ohm*, the unit of resistance; the *coulomb*, the unit of quantity; the *farad*, the unit of capacity; the *volt-coulomb* (or *vomb*), the unit of work; and the *volt-ampère* (or *waht*), the unit of power. The relations are that an ampère is a volt divided by an ohm. An ampère is a coulomb per second. A farad is a coulomb divided by a volt. A volt-coulomb is a volt multiplied by a coulomb. A volt-ampère is a volt multiplied by an ampère.

As these relations contain no coefficient other than unity, they express the relations between any quantities measured in terms of those units as well as the units themselves.

Prof. L. M. Haupt exhibited a drawing of the Phœnixville Bridge which was built by Mr. Moncure Robinson, C.E. (Honorary Member of the Club), in 1836, for the Philadelphia and Reading Railroad, over the river Schuylkill. It is an instructive and enduring monument of successful construction of cut-stone masonry. There are four segmental arches 72 feet clear span and 16¼ feet rise. Radius of arch, 47¼ feet. Voussoirs 2 ft. 9 in. thick. One end abuts against a rocky bluff, while the other is supported by a heavy abutment with an earthen filling. It is believed to be one of the lightest and cheapest bridges of its kind in this country, having cost but $48,000.

The Secretary exhibited samples of Japanese paper which he had obtained through Mr. J. A. L. Waddell. Many Japanese papers are of excellent quality and could probably be used with great advantage in engineering practice. The method of manufacture is kept secret to some extent, as there is no patent law in Japan, but the paper is made of new material instead of old rags, as in America. The best qualities are made of silk; the others probably of bark fibre. The sheets exhibited are about 35x24½ in. and would cost but a few cents each to import.

The Secretary presented the following communication, which he had received from Mr. E. Borda, member of the club:

"I inclose a few blanks being 'Application for Admission' and 'General Regulations' regarding an International Exhibition which is to take place next winter at Nice, France. Some of the members may desire to avail themselves of this opportunity. Mr. Leonard F. Beckwith, 229 Broadway, New York, is President of the Committee of Initiating in U. S., and I am a member of the committee. By applying directly to him or through me (326 Walnut street) for any further particulars, any one can obtain any information he desires."

Respectfully,
HOWARD MURPHY, Secretary and Treasurer.

PILE DRIVING MACHINES.

The machine illustrated is one of the very latest in model and the heaviest in New York Harbor.

The hull is 56 ft. 6 in. long and 28 ft. 6 in. wide over all; each of the sides of the hull is made of four pieces of yellow pine, the two lower each 8×14 in., the third 7×14 in., the top piece 6×14 in., all securely tied by through bolts; the bow planking is oak, 5 in. thick; the bottom and end plank yellow pine, 3 in. thick. The bow is further strengthened by a 16×16 in. cross-timber at top, and at the stern is an 8×12 in. cross-timber of yellow pine. Oak is used on the bow as being better adapted to stand the constant wear of the piles hauled against it; and to prevent knots or inequalities on the piles interfering with their position under the hammer the bow planking, overhangs 6 inches in its total height.

The chief end in the design of a hull for a floating pile driver is to obtain longitudinal stiffness, so that the strains between the bow and engine may be properly distributed. To this end our hull is strengthened lengthwise by four wooden bulkheads or kelsons, each six in. thick (Fig. 2.) and braced laterally by four sets of *X* braces of 6×6 timber. The hull is further braced in the center, by two 3×12 in. Y. P. braces, and tie rods or "hog-chains" of iron 1¾ in. in diameter. Wale-pieces and fender plank 3 in. thick protect the outside of the hull against chafing; the deck has a "crown" of about 6 inches in it total width.

The hammer-guides are made of two pieces of 12×12 Y. P. 67 ft, long from out to out with inside guides of 5×4 in., stuff protected by plate iron ¼ in. thick; ⅝ in. bolts with countersunk heads, fasten the inner guides to the main sticks and at the same time secure the iron-work to the same. The bottom of the main guides are connected with the 12×12 bed-pieces, shown in Fig. 3, by two timber-knees, and are tied at top by the cap shown in Fig. 6.

The dimensions and general arrangement of the back-bracing is fully shown in Figs. 1 and 3; the bolts used in this portion of the frame work are ⅞ in. diameter. The side-braces are round timbers 16 in. diameter at the butt, and they are anchored to the hull by two heavy timber-knees to each. The bed-pieces, as shown at Fig. 3, are fastened down to the hull by four bolts, each 1 in. in diameter, the forward bolts passing through the 16 × 16-in. oak piece on bow, and the after-bolts passing into a cross timber 6 × 14 in., as shown at Fig. 4. The foot of the back-bracing is secured to the bed-timbers by one 1-in. strap-bolt in each timber, the strap portion of bolt being 2 × ½ in. in section. A ⅞-in. through-bolt ties the three braces together.

The iron stay-rods running from head of guides to after part of hull are two in number, and are each 1 in. in diameter.

The hoisting sheaves on top are two in number placed side by side. They are 12 in. in working diameter, 15½ in. from out to out, and 3½ in. wide; and the pin passing through them is 2½ in. diameter at the sheaves, and 2 in. diameter in the boxes. Experience teaches that these proportions are none too great to stand the severe work frequently put upon it in hoisting heavy weights and tearing out timber. The fall-rope attached to the hammer is 2 in. in *diameter*, and the "runner" used in hoisting up piles is 1⅝ in. diameter.

The hoisting engine is a double-drummed Munday engine of a nominal 25 horse-power.

Fig. 5 shows the hammer used with this machine. The drawing is sufficient to show its general design. The weight is 3,300 lbs.

Fig. 7 shows the method of attaching the two 5×12 in. horizontal braces to the round side braces, as further shown in Fig. 2.

ON THE USE OF CONCRETE IN MARINE CONSTRUCTIONS.

The discovery in the early part of the present century of an artificial cement suitable for building purposes, and possessing in addition to great power of adhesion the extremely valuable property of developing its adhesive strength most favorably when submerged in water, forms probably the most important incident in the history of marine construction; and when it is further considered that such a material in the form of Portland cement has been readily obtainable at moderate cost it is only natural to expect that a great revolution should occur in the mode of constructing breakwaters, quay walls and other similar structures. That a considerable change has taken place is indicated by the now general use of large artificial blocks involving various forms of heavy machinery for their manipulation.

A review of some of the more recent harbor works in this and other countries leads, however, to the conclusion that while the superior adhesive power of cement and the rapidity of its development have been truly recognized and made use of, as for example in the building of concrete blocks on shore above high water, the more characteristic and not less important property, so far as hydraulic work is concerned, of setting after submersion does not seem to have received quite as much attention as it deserves, or to have been hitherto sufficiently taken into account in modifying the design not only of marine works, properly so called, but also of many other structures of equal importance, the foundations of which are laid under water. Nor does it appear improbable, when full advantage is taken of the hydraulicity of cement, that increased skill in the manipulation of plastic concrete under water will enable the larger rivers and estuaries to be economically bridged over, and will diminish the necessity either for excessively long spans, such as have in many cases been adopted for tunnels, the length of which and other circumstances render the cost of their healthful ventilation all but prohibitory.

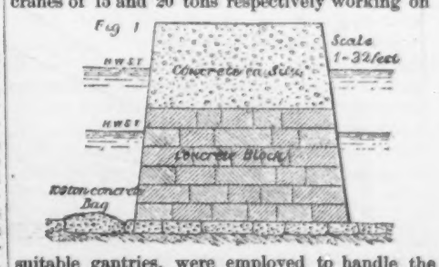
Much has been written regarding Portland cement, and many elaborate investigations have been made of its tensile and compressive strength, the former being used as a test of quality. In most cases, however, and particularly in that of concrete, the chief function of cement is to convert a quantity of loose material into a solid mass, and the excellence of properly proportioned concrete will, other things being equal, depend almost entirely on the *adhesive* strength of the cement used. It therefore appears somewhat remarkable that the test of *adhesion* has not been employed to determine the quality of neat cement in preference to the much less appropriate, and in some cases misleading, test of *cohesion* now so generally adopted.

As evidence that Portland cement possesses the property of developing adhesive strength under water to an extent calculated to meet all the requirements of practice, it may be stated that in the case of the softer building stones, as for example Portland and Sandstones, we have found from repeated experiment that on forcing asunder pieces of these stones which had been cemented and *immediately* afterward immersed in water, the adhesive strength developed in twenty-eight days was sufficient to tear out small fragments from the cemented surfaces of the specimens. It will perhaps be more convenient to reserve further remarks on this and some other parts of the subject relating to the submersion of plastic concrete until we have briefly reviewed the modes of construction adopted in some of the more recent harbor works, selecting a few representative examples.

The South Breakwater at Aberdeen furnishes an instance in which concrete was used in four different forms, involving different modes of deposition.

Fig. 1 represents a section of this breakwater at 800 ft. from the shore end. The foundation course consists of jute bags filled with concrete, and varying in weight from 5 tons to 16 tons each. The bottom on which they rest consisted for the most part of gravelly clay, covered with large stones; the latter were removed by divers, and the bags lowered into place in iron skips, furnished with hinged bottoms and triggers; the bags were submerged while the concrete was in a plastic condition, and the divers were thus enabled to manipulate them so as to accommodate the inequalities of the bottom and at the same time form a level surface on the top to receive the superstructure. The proportion of cement used in this part of the work was one part cement to six parts of a mixture of sand and gravel.

On this foundation course, concrete blocks 4 ft. high by 6 ft. wide, and varying in weight from 7½ to 24 tons each were laid in courses to a level of 1 ft. above low-water of neap tides; these blocks were lifted and lowered by two 25-ton steam travelling cranes supported on a strong timber staging, and were set in position by the divers. In the block yard a 25-ton steam and two overhead hand cranes of 15 and 20 tons respectively working on



suitable gantries, were employed to handle the blocks. The proportion of cement in this part of the work was one part cement to nine of sand and gravel. The upper portion of the breakwater above low water of neaps was formed of concrete *in situ*, filled in between suitable frames, and laid in

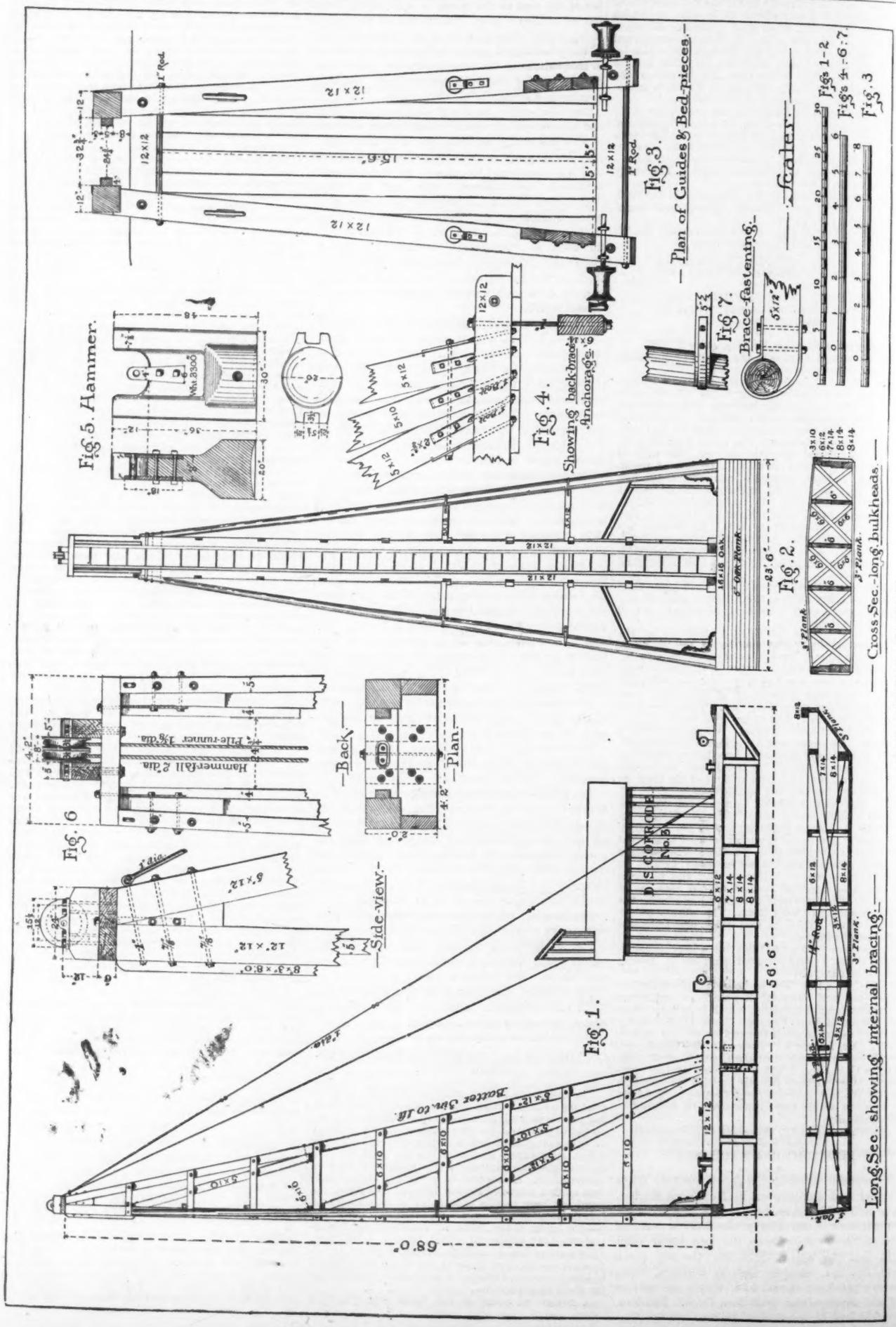


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Showing back-brace anchorage.
Fig. 5. Hammer.
Fig. 6
Fig. 7.
Brace-fastening.
Plan of Guides & Bed-pieces.
Cross Sec.-long. bulkheads.
Long Sec. showing internal bracing.
Back.
Plan.
Side-view.
Scaler.
Figs 1-2
Figs 4-6-7
Fig. 3
68'0"
56'6"
23'6"
Hammer-fall 2" dia.
Pile-runner 1⅞ dia.
D. St. CONCRETE No. 5
PILE DRIVING MACHINE.

such lengths that the filling could be carried up in advance of the rising tide, so that the upper surface of the concrete was always kept above water; the proportion of cement in this part of the work was one part cement to seven parts of sand and gravel; occasionally in fine weather, and when not likely to be injured by the wash of the sea, the proportion was decreased to one cement and nine of sand and gravel.

To prevent the toe of the breakwater from being undercut, an apron was provided consisting of long bags of plastic concrete, weighing 100 tons each, and dropped into a place from a box about 8 ft. wide by 6 ft. deep, having a hinged bottom, and supported on brackets fixed to the side of the finished part of the breakwater some feet above high water. This method of protecting exposed footings had never before been adopted, and would no doubt prove extremely effective, provided the bags retained their form and were not burst before their contents had hardened. The concrete for this and the other portions of the work was made by four of Messent's mixers, driven by an 18 horse-power engine, each mixer turning out 12 cubic yards per hour; materials for the concrete, and also stone, were obtained within easy distances. The number of divers employed was thirty-two, their wages averaging 66s. per week, namely, eleven shifts of four hours each at 6s.

The breakwater has a length of 1,050 ft., and the total cost of its construction, given by Mr. D. Cay, in the revised statement of expenditure following his lucid description of the work,* has been about £78,000; the cost of plant, temporary buildings, etc., was somewhat under £30,000. Deducting £10,000 for the estimated selling value of the plant, etc., after completion of the work and dividing the balance of £20,000 over the different items, their relative amount and cost is stated to be approximately as follows, omitting interest on the first cost of the plant, which will be further alluded to:

	Cubic yards.	Cost per cubic yard.
Excavating foundations		£4.904
		£ s. d.
Concrete in foundation course	3,202	1 15 5
" apron	1,336	1 17 0
" blocks	22,851	0 16 1
Block setting	22,851	0 11 5
Concrete *in situ*	23,972	0 18 7

The cost of the timber staging is put down at £10,292, which although considerable, can scarcely be regarded as excessive, when it is remembered that heavy crane machinery and blocks had to be carried at a considerable elevation above high water and in an exposed position. Portland cement stored at the works cost 43s. per ton.

The most noticeable feature in the construction of the Aberdeen breakwater is the use of the 100-ton bags of concrete and the method of depositing them. Their cost, however, as well as that of the smaller bags in the foundation course does not compare favorably with the other portions of the work; the superior economy of concrete *in situ* is also well illustrated. The total contents of the breakwater below low water amounted to a little over 27,000 cubic yards, of which about 23,000 cubic yards had been allowed to harden or "set" in air, the remainder in water. Preparations for commencing the work were begun in May, 1869, and the breakwater was completed in September, 1873. During this interval 51,361 cubic yards of material were deposited at the average rate of nearly 1,000 cubic yards per month; or, taking 300 working days to the year, an average of about 40 cubic yards were deposited per day. If larger blocks, say for example, of 50 tons each had been used, the rate of progress would, no doubt, have been somewhat greater, but on the whole the experience gained at Aberdeen cannot be considered as favorable to the use of moderate sized blocks, the cost of fixing them in place exceeding two-thirds of the cost of the block itself. A similar comparison with respect to the concrete in bags shows the setting to have cost rather more than the material set. These comparisons are to some extent admissible, as the price of concrete—allowance being made for differences in the proportion of cement—should not vary much beyond moderate limits, for sand and gravel can generally be obtained close to the site of the works, and the difference in the cost of cement in other countries is frequently compensated by the reduced price of labor.

It is a matter of importance in marine constructions to provide means for the rapid deposition of the building material, particularly under water, so as to enable full advantage to be taken of the comparatively limited intervals of calm weather, during which the work can be more satisfactorily and economically proceeded with. One of the weak points of the system adopted at Aberdeen—and noticeable also in similar works at other places—was the large amount of diving-work required. In even moderate depths, and particularly when exposed to tidal or other currents, diving operations are so extremely slow and expensive that any system involving much work of this description must be considered more or less defective and unsatisfactory.

The method of building with blocks is open to this general objection, as it always involves the accurately leveling of the foundation, whether natural or artificial, which is a tedious and costly operation in the great majority of cases. Each block has also to be carefully placed in its proper position under water, and this can rarely be accomplished without the assistance of divers and their attendant encumbrances. It is further objectionable that under such circumstances the engineer is placed to an undesirable extent in the hands of his divers, whose reports he must as a rule accept, and carelessness on the part of the diver to which on account of his encumbered condition there is considerable temptation, can seldom be detected in time to have it properly remedied.

A system therefore in which the employment of divers was reduced to a minimum, or practically dispensed with—and that such a system is in many cases possible there is little reason to doubt—would, other things being equal, have much to recommend it, and would probably supersede many of the methods at present adopted.

It has been a frequently expressed opinion that blocks of a much larger size than those used at Aberdeen would have been preferable; this, however, if they were manipulated in a similar manner, would necessitate an extremely massive sea-staging and very heavy machinery, requiring an almost prohibitory outlay, the cost of the former item in the case under consideration amounting to over £10,000. Other methods of lifting and lowering large masses of built concrete, in which the use of a sea-staging is avoided, will be subsequently referred to, but that they are capable of being economically employed in exposed situations is extremely doubtful.

With respect to the statement of expenditure on the Aberdeen works, we should be disposed to suggest the following modification: As before noticed, the total expenditure on the breakwater amounted to £77,973, of this £29,723 was expended on plant, including sea-staging, etc., the estimated value of which, after the work was finished, is assumed to have been £9,878. From this sum, however, is to be deducted, for the purpose of comparison with other works, interest on the first cost of the plant, amounting to about £6,300, making the net total cost about £74,400. The following is a summary of the approximate quantities and prices connected with the work, adopting the modification above referred to:

Total length of breakwater	1,050 lin. ft.
Total contents of breakwater	51,361 cub. yds.
Quantity per lineal foot	48.91 "
Total net cost	£74,400
Total net cost of plant	25,145
Cost per lineal foot of breakwater, about	70
Cost per cubic yard of finished work	29s.

The selling value of old plant and materials is difficult to estimate and liable to be overrated, particularly if the former is of special construction or design. For the purpose of instituting a comparison in such cases, it will, perhaps, be sufficiently near the truth if the average selling value of the plant is taken at one-fourth of the first cost.

In comparing the cost of special plant with that of work executed it is expedient in order to avoid complication, that the latter item should be confined to the amount actually effected by the direct use of the special plant, and that other parts of the structure which may have been built quite independently should not be included. For example, if the superstructure in one case was of rough concrete extending only a few feet above high water, and in another it consisted of a large quantity of expensively-dressed ashlar, carried from low water to a considerable height above high water, although in each case the special plant may have done the same amount of work, it is obvious that a comparison which referred to the whole cost of each of the finished structures would be misleading. Applying these restrictions to the case of the Aberdeen works, and limiting the special plant to "cranes," etc., and "sea staging," we may assume the united first cost of these items to be about £20,000, which, with interest at 5 per cent. for 4½ years (the time occupied in construction) amounts to £24,300, from which is to be deducted one-fourth of the first cost as the selling value when the work had been completed; the approximate net cost would therefore be about £19,000. The special plant was directly employed in all the work except the superstructure deposited while plastic above low water, containing 23,972 cubic yards, which being deducted from the gross quantity of material in the breakwater makes the total work done by the direct use of the special plant to be 27,400 cubic yards, which were lifted and lowered into place under water at an approximate cost for plant alone of about 14s. for each cubic yard deposited. The accuracy of these figures may be questioned on the ground that all the cranes may not have been exclusively used with the blocks and bags. Any discrepancy on this account, however, would probably be more than counterbalanced by other items the cost of which is not included. Of course, other things being equal, double or treble the quantity of work might have been done by the same plant, in which case only the additional interest for the increased period of use would have to be taken into account. The cost of the special plant as given above, and the amount of work executed, will, as we shall show on a future occasion, compare favorably with the same items in some other works of a similar character. On the whole, the south breakwater at Aberdeen forms an important example of marine construction in an exposed position, and reflects much credit on the engineer in charge, Mr. W. D. Cay, the difficulties of the case being met and overcome with considerable skill and originality. In a future article we shall deal with some other modes of applying concrete in marine construction.—*Engineering.*

* Minutes of the Proceedings Institution Civil Engineers, xxxix.

THE RAILWAY EXPOSITION.

Repeated visits to the Railway Exposition, now closing its second week, impress one forcibly with the fact that it is a grand affair. In an attempt at methodical examination of each and every exhibit, one is at the outset dismayed at the prospect. The whole enormous field of railway appliances, supplies and equipment is so completely and so fully represented that the month allotted for the continuance of the Exposition allows far too little time for an exhaustive inspection,

The public, having become satisfied that the Exposition is now in full running order, is bestowing its patronage quite freely, and the crowds in attendance are growing larger daily. Several railroads and large manufacturing houses are beginning to send in excursion parties of their employés, for the purpose of broadening their mechanical knowledge and experience. During the next two weeks members of the Master Car-Builders, the Master Mechanics and the Telegraph Superintendents' Associations, and of the American Society of Civil Engineers, will visit the Exposition on the occasion of their annual conventions, so a large attendance may be counted on for the closing weeks of the Exposition.

With the increasing patronage comes a greater unanimity of good feeling among the exhibitors. Some of the latter have found occasion, one way and another, to find fault with the administration of the affairs of the Exposition, and the resultant "talk" has found its way into the columns of several newspapers. In affairs of this kind there is always fault-finding, with more or less basis of reason. An undertaking of such magnitude as the Railway Exposition cannot in the nature of things be run without the commission of more or less error by the management. It would be strange indeed if every one of some thousand exhibitors were pleased in every way. But the principal cause of fault-finding that has come to our ears, has been such as to warrant nothing of the kind. We refer to the matter of entrance fees, admission tickets and space rates. The rules governing these matters were explicitly set forth in the original prospectus of the Exposition, and there is no basis of reason for objecting to regulations so publicly announced—this, with an exception as to entrance fees. The wording of the prospectus was somewhat ambiguous in this regard, but with those with meritorious displays this should be a small matter. We think that the fault-finders on this score appreciate their weak position, and are disposed to change base. Certainly smiling faces are the rule now.—*Railway Review.*

"TABLES Relating to Flow of Water in Cast-Iron Pipes" is the title of a small book just published by G. A. Ellis, City Engineer of Springfield, Mass., and A. H. Howland, C. E., of Chicopee, Mass. These tables are intended for clean, cast-iron, bitumenized water pipe, under the average conditions of practical work. The curve of resistance adopted is greater than that of Darcy and less than that of Eytelwein. Their application is threefold: First, to ascertain the frictional resistance or loss of head or pressure within any size of pipe, from 4 in. to 36 in., while discharging given quantities of water. Second, conversely, to find the quantity of water flowing from any size of pipe, from the reduction of pressure. Third, to ascertain the maximum volume which any size water pipe will discharge under a given head.

This book of tables may be called an Addenda to the "*Work Required for Fire Streams,*" published by Mr. Ellis in 1878, and with which it corresponds in size. For further information address Mr. Ellis personally.

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

The Engineering News Publishing Company, Proprietor.

Published Every Saturday.

CONDUCTED BY

GEO. H. FROST and D. McN. STAUFFER.

TERMS OF SUBSCRIPTION:

$4.00.....PER YEAR TO U. S. AND CANADA.
$5.00 .. .. " " " FOREIGN COUNTRIES.

Make all drafts and cheques payable to ENGINEERING NEWS PUBLISHING CO. Postal Money Orders, for convenience, may be made payable to GEO. H. FROST.

NOTICE OF MEETINGS.

NEW ENGLAND WATER-WORKS ASSOCIATION.

The second annual meeting of the above-named organization will be held at Worcester, Mass., June 21 and 22.

The head-quarters of the Society during the convention will be at the Bay State House, in that city, at which place members are requested to assemble on Thursday, June 21, at 10 o'clock a. m.

It is hoped that each city and town in New England having a water supply will be represented at this gathering, and a hearty invitation is hereby extended to all eligible to join the Association.

Members of water boards are cordially invited to be present at any meeting of the Association.

It is desirable to know the number that will be present. All those expecting to attend should promptly notify

FRANK E. HALL, Water Commissioner,
Worcester, Mass.

An assessment of two dollars will be made on each person present to defray expenses of room for meetings and the dinner on Thursday.

R. C. P. COGGESHALL, Secretary.

NEW BEDFORD, Mass., June 7.

PROGRAMME.

Thursday, June 21.—10 a. m., business meeting, annual reports, election of officers for the ensuing year, etc.; 1 p. m., dinner; 2 p. m., visit to Worcester Water-works; 7½ p. m., discussion on the following topics: 1st. The causes and prevention of the waste of water. 2d. Uniformity in preparing the annual report. 3d. Water meters. General discussion.

Friday, June 22.—By invitation of the Chapman Valve Manufacturing Company, a visit to their manufactory at Indian Orchard, Mass.

Now that reports with regard to business are apt to be too one-sided—too gloomy—it is significant to find that three railways, the N. Y. Central, the Erie and the Pennsylvania, have increased their traffic from 2,682,603,465 ton-miles in 1870 to 8,263,038,412 ton-miles in 1880, or 300 per cent. At the same time the locomotive works and car-works are very busy with orders ahead for months. The great trade and transport movement of the country still increases.

MONTREAL'S CITY SURVEYOR AND THE COMMITTEE.

To the Road Committee:

GENTLEMEN.—The demand herewith, of Mr. McKeown, is not for any balance due, as there is nothing owing to him on account of the flagstone work done last year; but, as has been explained by himself to your Committee, it means that he desires to be paid certain amounts which I deducted from him last summer for inferior work, and which, when so discounted, was amply paid for, and the work was accepted by me only on condition of such deduction in price. There is therefore nothing due to Mr. McKeown on this account.

For the information of your committee, as desired, I herewith submit a memo. showing the pieces of work and the amounts deducted.

As your committee have indicated an intention of paying Mr. McKeown's demand, I beg to say that the last warrant made in his favor, for the Victoria Square flagstone, was refused payment by the City Auditor, notwithstanding the signatures of members and the resolution of your Committee, unless the warrant was also signed by me. So as not to obstruct the carrying out of your Committee's decision, I signed the warrant with the prefix, *pro forma*, before my name. The City Auditor maintains that my signature to a warrant is necessary, according to law, before he can certify for payment, and that in case of contract work it is interpreted by the Finance Department as a certificate that the work which it is in payment of has been accepted by me, as being in accordance with the terms of contract. It is, therefore, plain that I cannot so stultify myself as to do what would, in effect, be an acceptance before the Council of that which I had rejected before your Committee. The opinion appears to obtain with some of the members of Council that a resolution of your Committee ordering payment of any work which I may have rejected relieves me of all responsibility, and renders my signature to a warrant a mere matter of form. Were this the case it would be unnecessary for me to raise the question, excepting only to say that if it was so, my signature should not be needed. But such is not the case, nor is it the general interpretation of my signature. May I respectfully request, therefore, that a proper understanding of the by-law be arrived at with the least possible delay.

Respectfully yours,
GEO. D. ANSLEY, City Surveyor.

The above letter from the Montreal *Daily Star* of June 7 contains some sound and manly advice to meddling committeemen in other towns than Montreal. In the controversy which followed the reading of this letter the City Surveyor was roundly censured by some of the Aldermen present for presuming to differ from them in the acceptability of certain engineering work; and that Mr. Ansley should make the proposed reductions for bad work seemed to them ridiculous, when they in their professional wisdom had pronounced the work "good enough." It was even proposed to rescind a previous resolution, instructing the City Engineer "not to receive any work which was not according to the specifications."

Mr. Ansley will have the sympathy of more than one city engineer we are assured, for this unwarranted interference with the duties of the office is entirely too common. Why an election to the municipal councils should, by virtue of that election solely, make, from a tailor perhaps, an expert in the science of engineering, and why it should make him an engineer, rather than a doctor, a lawyer or a preacher, is just one of the conundrums in city organization that no man can solve.

The average politician fails to appreciate the previous training, education and experience, the sturdy honesty and sound native common sense requisite to make a civil engineer in the proper acceptance of the term. As a consequence, the worst fitted professionally among the candidates is too frequently selected for the office; but then he may *not* object to bad work when the interest of himself and that of his patrons lies in the direction of its acceptance.

The idea that any "practical" man can be an engineer without previous practical experience in that particular line, is long ago exploded. A *good* engineer must be a thoroughly practical man, but the reverse does not hold good.

ON THE EARLY HISTORY OF THE EAST RIVER BRIDGE.

A recent publication in pamphlet form, issued by the enterprising firm of Fred. Loeser & Co., dry goods merchants of Brooklyn, gives a clear description, with copious illustrations, of the great East River bridge, prepared by Gen. A. C. Barnes, one of the bridge trustees, and we may presume that as he speaks *ex cathedra*, his statements may be taken as conclusive on some mooted points, notably that of the original inception of the work. This he most emphatically states as undoubtedly due to Col. J. W. Adams, of Brooklyn, whose original design furnished the basis upon which application was made to the Legislature for a charter, which after much effort was obtained in 1867; but as Mr. Barnes also states that this design of Colonel Adams was a "comparatively light and inadequate structure," we were desirous of ascertaining the successive steps by which from imperfect beginnings the present stupendous affair was reached, and accordingly addressed a note to Colonel A. asking information upon this point, and as we may presume it of interest to the profession, we publish his reply.

To the Editor Engineering News:

The paper of Mr. A. C. Barnes to which you refer is satisfactory so far as it indicates the opinions of a member of the Board of Trustees as to the early inception of the work; but the reasons assigned by him, or rather implied, as having led to the abandonment of the original design for the one executed are entirely inferential on his part, and, if correct, would reflect but little credit on the judgment of the early promoters of the enterprise—the committees of the legislature—the legislators themselves, or the sagacious capitalists who proposed investing their funds in the enterprise, as having one and all contemplated the erection of a structure totally inadequate to the purpose in view, and which they were subsequently induced to abandon for the design as we now see it executed, and which a competitive examination of plans had shown as alone suited to the requirements of the case, the plan which had previously filled the public eye, and upon which the charter of the company was based, having been laid aside as a "light and comparatively inadequate structure." This inference of unsuitableness drawn by Mr. Barnes is scarcely sustained by the facts, which, it is very probable indeed, his comparatively late connection with the Board of Trustees had left him in ignorance of, no question of the comparative merits of respective designs ever having come up for decision.

After obtaining the bridge charter, and when intending to come before the public for subscriptions to the amount of millions of dollars to carry out so stupendous an enterprise, the directors conceived that the name of an engineer—Mr. Roebling—then well-known in connection with the construction of the largest suspension bridges in the country—we may say, in the world—would prove an important factor toward inducing public confidence in the feasibility of the undertaking in which they were interested, and they accordingly appointed Mr. John A. Roebling of Trenton as Chief Engineer, in May, 1867. Whatever plans Mr. Roebling might ultimately bring forward as his design for this work (and up to this time he had presented none), they would be likely, it was thought, to secure the confidence of the public, and so conduce to the end for which the directors were striving, viz., raising the requisite funds for its construction. It was not a question of *plans*, but of *men*. All this, however, with the requisite documentary evidence, has been stated sufficiently in detail by me, in an interview with a reporter from the office of the Brooklyn *Eagle*, and published with much other matter bearing upon the early history of the bridge, in its issue on the day of the opening, 24th May, and briefly alluded to in your issue of January 20th, and I need say no more on this head than to quote for the first time, the opening paragraph of the report of the Board of Consulting Engineers, called in by the directors early in 1869 at the request of Mr. Roebling, who had stated to the directors "that it was right and proper before going forward with the work, that his plans should be subjected to the careful scrutiny of a board of engineers, convened for the purpose, in order that, if his plans received their approval, the enterprise would stand before the public sustained by their professional judgment, and would not rest solely on the judgment of one single engineer."

Extract from report of Board of Consulting Engineers:

(The italics are our own.)

"On coming together as a board, our first object was to obtain a clear knowledge of the object for which the board had been convened. It was then ascertained that the object was not one of service to the directors in their consideration of the plans proposed, or their action on the adoption of the plans, *for that consideration had been given and that action had been taken and was before the public;* and, also, that it was not the object that the engineer of the company should have the aid of the counsel and suggestions of this board in maturing his plans and deciding the many important questions involved in the proposed structure, *for the plans had been matured and the decisions had been presented in a report,* stating fully and clearly the general character of the structure, with such reference as to details of combination and preparations as was appropriate."

I had the honor to serve on this commission of seven well-known engineers, and we unanimously approved of the plans of Mr. J. A. Roebling—not that it was the sole method in detail through which the result aimed at could be achieved, nor that it was the best plan that, in our individual judgments, could have been devised to meet the end in view, for no other plan was presented to us for comparison or report—but that as a Board of Engineers we concurred in the following opinion, viz.:

"That it is beyond doubt entirely practicable to erect a steel wire suspension bridge of 1,600 ft. span, 135 ft. elevation, across the East River, in accordance with the plans proposed by Mr. Roebling, and that such structure will have all the strength, stability, safety and durability that should attend the permanent connection by a bridge of the cities of New York and Brooklyn."

Such was the report of the board of engineers.

The friends of Mr. Roebling will understand, that in responding to your note of inquiry more

fully as to "the light and inadequate structure" which I had previously proposed for a bridge at this place, I would not be understood as endeavoring in the slightest degree to weaken the claims of these gentlemen (father and son), to the highest consideration due them for both the design and execution of this great work, for which they, and they alone, are entitled, and their reputation as engineers would be in no wise enhanced by undervaluing the claims of others to having pointed out the way by which equally satisfactory results might have been achieved, as it cannot be maintained at this day that there is but a single and solitary method by which the results we now contemplate could have been reached, and that the prescience which at that day, and before the inception of the work, could anticipate results was confined to a single individual!

In my inter course of many years with the late John A. Roebling I had learned to appreciate his great ability and sagacity as an engineer, and acknowledge my great obligation to him for information from his copious store of practical experience as an iron worker and bridge builder, and which he was always ready to impart without reservation, and while I owed much to his practical methods of dealing with and utilizing theoretical investigations, I flattered myself, with what truth time will show, that as I was not hampered with a large interest in special manufacturing, I was free to adopt my designs to the needs of their locality, and "nothing like leather" formed no part of my creed. In other words, I did not then, nor do I now believe, that all suspension bridges, large or small, whatever their environments, should be built of *wire*, but that in some localities, notably in this, where a renewal of the supporting cables might from any cause become either necessary or desirable, bars of steel, which would admit of such renewal or change of dimension without interrupting the traffic, was the proper material for the cables in lieu of wire. Nor that an excessively wide single floor or platform, supported at various intervals between its extremities, was as suitable for miscellaneous and varying traffic as a narrower platform, supported by chains at its extremities only, and its capacity for miscellaneous traffic provided for by several shorter floors. Nor that six shallow longitudinal trusses were as efficient in stiffening the floor system as were three trusses of double the depth applied to half the width of floor.

Such were the leading differences in our respective designs for this bridge; but as a discussion of their respective advantages is not called for at present, I beg leave to show how far this plan of mine was a comparatively *light* structure, by quoting from a paper descriptive of the two designs read before the American Society of Civil Engineers, and published in the Brooklyn *Union* of Oct. 7 and 9, 1867, from which it will be seen that the plan as proposed by me was many tons heavier in a shorter length of bridge than was the *original* design of Mr. Roebling. Important changes, making great increase of weight, took place during the construction of the present bridge, which increase of weight might or might not have been considered necessary had my design been carried out, but the comparison of respective weights in the two designs will show how far the expression "comparatively light" will properly apply to my design; and as to its adequateness or otherwise for the purpose in view, I can only say that as yet no board of engineers have ever been called upon to determine it.

I would remark, that my original design contemplated two floors, one for general traffic representing a street 50 feet in width, and a lower floor for foot passengers 25 feet in width. Subsequently this was modified to three floors, an upper one for general traffic, with two tracks for street cars, being 36 feet in width, with an overhang of 6 feet in width on each side, if thought necessary for foot passengers, a middle floor with two tracks for railroad; and a lower floor with two passenger ways, each 10 feet in width; and it is this latter plan, which connecting with Chatham Square in New York, and much shorter than the Park line as designed originally by Mr. Roebling, that is compared with the latter line in the paper referred to above as published October, 1867, from which we take the following:

COMPARISON OF DIMENSIONS AND CAPACITY.

	Roebling.	Adams.
	Feet.	Feet.
Extreme length of bridge	5,862	4,450
Suspended over East River	1,600	1,404
Deflection of cables or chains	128	108
Aggregate width of platform for foot passengers	27	32
Aggregate width of platform for rail and cars	26	46
Aggregate width of platform for general traffic	18	36
Aggregate width of platform for slow and fast travel either way	None.	36
Number of railroad tracks	2	4
Number of suspension cables or chains	4	2
	Tons.	Tons.
Weight of bridge, exclusive of cables	2,675	2,172
Weight of steel cables or chains	1,223	1,837
Estimated extreme load of passengers, cars, etc	1,270	1,740
Total maximum load	4,753	5,749

Not having the designs before me from which the above was computed, I have no means for checking these figures, but presume them to be accurate. JULIUS W. ADAMS.

PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS.

The last papers issued by the Institution are "Mild Steel for the Fireboxes of Locomotive Engines in the U. S. A.," by John Fernie; "The design and Construction for Repairing Shipways for Ships," by Thomas Bell Lightfoot and John Thompson: "The Antwerp Water-Works," by Wm. Anderson; "Economical River Training in India," by Carlton F. Tafnell: "The Iquique Railway in Southern Peru," by H. Sadleir Ridings.

THE ANTWERP WATER-WORKS: Population 200,000; sewage arrangements imperfect, the surface water only is allowed to discharge in such drains as exist; cess-pits emptied by night-carts receive most of the sewage; soil sandy and porous, making use of wells dangerous. The well water is hard and impure, unfit for use in steam boilers. The new water supply is taken from the River Nethe, 11 miles from Antwerp, as the quality of this, the nearest available source, is bad, the water before delivery is purified by passing through a sand and spongy-iron filter.

The terms of the concession require 33 gallons per head for 175,000 people. The works at Waelhein, 11 miles from Antwerp, consist of 2 settling ponds, 3 spongy iron filters, 3 sand filters, 2 filtered water reservoirs, 2 12 H. P. engines, and Airy screw pumps to lift water from settling pond to filter 2 sets of 170 H. P. pumping engines for direct distribution, 4 boilers, air vessels, and a 20 in. forcing main to Antwerp.

The settling ponds were excavated in the natural ground, with slopes of 1½ to 1, and contain 1,320,000 gallons each; the bottom and sides are paved with stone 5 in. thick, laid dry. A 12 in. centrifugal pump worked by a turbine under pressure from the main, discharges into the river the sediment, being connected with both basins by a 12 in. main and sluice cock. The water is taken from the river into these settling basins by a 42 in. cast-iron pipe, 150 ft. long, with an inward slope of 1 in 36, and with two branches leading to basins; the stops on this pipe are worked by hydraulic pressure from the 20 in. main.

Two Airy screw pumps, each driven by an independent 12 H. P. engine, and with screws 42 ft. long, 3 ft. diameter, and laid at an angle of 30°, arranged for a maximum lift of 19 ft., deliver up to 2,000 gallons per minute, from the settling basins to the filter beds. These screws serve as excellent water meters, and a "counter" records the number of revolutions. These pumps deliver into cast-iron hoppers, connected by a 20-in. main with the spongy-iron filters. To guard against action of frost on the filter-beds, the water raised by the screw pumps is heated a few degrees by injection of live steam from a 3-in. pipe fitted with a common mushroom valve, opening outward, steam enters the pump well. A rise of 1° Fahr. requires 15 horse boiler power. The spongy-iron filters are entirely above ground, 9½ ft. deep, with both bank slopes 1½ to 1; each basin 110 ft. square at top of bank. The filters are filled in the following manner: On top is 2 ft. of Meuse sand, then 3 in. of fine gravel, finally 3 ft. of spongy iron and gravel, mixed in the proportion of 1 part iron measure to 3 parts gravel. The filtering material rests on a close layer of brick on flat covering channels of brick on edge, all laid dry; 18 in. of puddle protect the banks on inner sides, and over this is 6 in. of concrete; above the level of the filtering material is stone paving 3 in. thick with only 12 in. of puddle. The water is delivered into each filter from a 20-in. main, through a 12-in. branch, with valve; a cast-iron trough protects the sand from scour; 3-in. air pipes are laid in the corners of the filters.

The effective area of each spongy-iron filter, taken at its mean depth, is 8,244 sq. ft., supposed to be capable of filtering at the rate of 800 gallons per minute, or 140 gallons per sq. ft. for 24 hours. The weight of spongy iron in the 3 filters, including a small reserve, is 942 tons, worth at Waelhein £8,000 ($40,000).

The sand filters are of the same dimensions as the spongy-iron filter beds, except that the puddle is only 12 in. thick. On the brick channels lie 12 in. of coarse gravel, then 3 in. of fine gravel, finally 2½ ft. of Meuse sand. The effective filtering area in each basin is 9,801 sq. ft., capable of filtering at the rate of 800 gallons per minute, or 1,179 gallons per sq. ft. per 24 hours.

In order to regulate the flow from spongy-iron to sand filter, and to aerate the water, the water passes from one to the other through a 12-in. pipe turning upward, and terminating in a sliding bell-mouth overflow with a spreader plate; this overflow is regulated by a screw and hand wheel.

The clear water tanks are each 60 ft. in diameter 10 ft. deep, made of cast iron flanged plates, and contain in aggregate 340,000 gallons; they are connected by a 24 in. main and by 15 in. mains with the sand filters. These tanks, owing to the porous nature of the soil, are set on 2 ft. of concrete, the bottom plates are 5 ft. square, and at the intersection of these plates rise 101 four in. columns 10 ft. high, carrying eleven rows of 9½ in. cast iron beams. Between the beams a 4½ in. brick arch is turned and the spandrels filled with concrete; over all is a layer of 5½ ft. of earth. A 24 in. main leads from the tanks to the pump well of forcing engines. The main pumps are two pairs of compound, expansive condensing beam engines of 170 H. P. each, they pump direct into the distribution, there is no water tower, but on the main is an air vessel 4½ ft. in diameter 20 ft. high. The stack to boiler house is 3 ft. 1½ in. square inside, 80 ft. high.

After 18 months' experience, the spongy-iron filtration is found to work well; the water is delivered bright and pure, and the bed of iron and gravel seems to be unaltered. The quantity of suspended matter is such that the top layer of sand in the iron filter must be scraped off and washed once in six to nine days, and the whole of the sand washed once a year; the upper 6 in. of the iron layer requires loosening about once in 6 months. A gang of seven men takes one day to scrape off and replace the sand of one filter, and 33,000 gallons of water are used in washing it; the cost ranges from "9d. to 10½d." per cubic yard of sand washed, including a charge of "2½d." per 1,000 gallons for water used. The periodical breaking up and washing of the upper layer of spongy iron costs "£14" ($70) for each filter.

Including the entire distribution, the works cost £3,800,00 ($1,400,000).

The following table gives some interesting comparative figures:

	German pipe 19⅝ in. dia.	English pipe 20 in. dia.
Length of pipe exclusive of socket	13.1 ft.	12.0 ft.
Thickness of metal	0.65 in.	0.75 in.
Wt. per lin. yard	3.67 cwt.	4.50 cwt.
Wt. per lin. yard 20 inch pipe	3.78 cwt.	
Test pressure	850 ft.	450 ft.
Price per ton, delivered in Antwerp	£7 2s. 6d.	£6 11s. 0d.
Price per lineal yard	£1 0s. 2d.	£1 9s. 6d.

FOREIGN ENGINEERING ITEMS.

(Specially arranged from exchanges.)

TESTING ASPHALT.—M. Claye dissolves the sample in sulphide of carbon, evaporates the residuum by filtering, and heats it until it can be reduced to a fine powder. He then digests a decigram of this powder during twenty-four hours in five cubic centimetres of sulphuric acid. Ten cubic centimetres of water are then slowly added, and then the matter filtered and diluted with 100 cubic centimetres of water; if the asphalt is pure the liquid will be colorless or a pale yellow.

A TREATISE ON IRRIGATION in the Valley of the Po has been published by M. Herisson. The work is said to be very complete.

TIME IN LEVELING.

EDITOR ENGINEERING NEWS:

Having recently to re-run some levels over the Allagheny Mountains, my leveler made what I think to be extraordinary "time." If any one can show a better record I would be pleased to know the conditions under which it was made. Below I give the conditions of the run made:

Distance, 1¼ miles; elevation overcome, 880 ft. Number of pegs driven corresponding to the number of times the instrument was set up, 85; length of rod, 12 ft.; variation between this and the previous levels, 0.07 ft. Time, 2 hours and twenty minutes.

Very respectfully,
J. M. R. Jr.

BEDFORD, Pa., June 7, 1883.

IMPROVEMENT OF GREEN'S POND.

NEW BRUNSWICK, N. J., June 13, 1883.

EDITOR ENGINEERING NEWS,

DEAR SIR: In regard to my article on the improvement of Green's Pond, I desire to state that owing to a misapprehension of my duty to the committee, to Mr. Earle, and my status under them I took a title which they did not consider I had a right to, inasmuch as all the plans were made by Mr. Earle and the work done under his personal supervision and direction, and published information that should have been reserved until after Mr. Earle's official report to the subscribers as the engineer of the pond. Yours, etc.,

GEO. HILL.

PERSONAL.

THE commencement exercises of the graduating class of the Stevens Institute of Technology were held on the 14th.

FRANKLIN COGSWELL PRINDLE, M. Am. Soc. C. E., U. S. Navy Civil Engineer, Brooklyn, N. Y., was elected Member of the Institution of Civil Engineers, May 29.

GEN. ARMSTRONG, U. S. Railway Commissioner; Col. HAGARD, Chief Engineer of the Department of the Interior, Washington, and Major CURTIS, of the Texas Central & Southern Pacific systems, are traveling in Texas and Mexico.

FREDERICK H. ROBINSON, First Assistant City Engineer of Wilmington, has been elected City Engineer, vice M. C. CONWELL resigned. GEO. H. BOUGHMAN and F. C. HATTON were elected First and Second Assistants respectively.

RUDOLPH HERING, M. Am. Soc. C. E., Past President of the Engineers' Club of Philadelphia, and well known as one of the leading sanitary engineers of America, was elected Member of the Institution of Civil Engineers, May 29.

GEN. H. G. WRIGHT, Chief of Engineers, U. S. A., passed through St. Paul recently on a tour through the Northwest. He intends to see what improvements have been made and what others are necessary to carry out the design of the government in making good harbors and navigable rivers. Gen. Wright will visit Duluth, Superior and the Red River Valley, and then extend his trip to the Missouri.

THE body of ANT. A. MCSWEENEY was lately found lying on the railroad tracks in St. Paul, Minn. He was draughtsman in the office of the Board of Public Works. MCSWEENEY was an old settler in St. Paul, and was assistant city engineer under Engineer BOYLE in 1856. He afterward went to the mountains, returning to be an assistant under Major WARREN, of the United States Engineer Corps. He was 55 years of age.

MR. JAMES CUNNINGHAM, one of the oldest and wealthiest contractors of this city, died on the 9th at his residence, 713 Lexington avenue. He executed the most important contracts awarded by the old Croton Aqueduct Board, and when JAMES FUREY was Commissioner of Streets had many of the heavy city contracts. He was born in 1801, and in 1832 married the wife who survives him. He leaves two daughters and three sons.

The Rensselaer Polytechnic Institute held its commencement exercises in Music Hall, Troy, on Wednesday. Rev. HENRY C. MCCOOK delivered the address, The annual banquet was held in Harmony Hall. At a meeting of the trustees of the Institute held same day, Mrs. WILLIAM HOWARD HARTS, of Troy, presented the Institute, as a memorial of her late husband, with $60,000 to endow a professorship of rational and technical mechanics.

The names of the graduating class at Stevens Institute for this year are JOHN B. ADGER, JR., MORGAN BROOKS, LEWIS C. DAWES, E. D. ESTRADA, F. C. FRAENTZAL, MAX HARING, A. P. HENDERSON, HENRY A. HICKOK, F. K. IRWIN, FRANK MAGEE, JR., MALCOLM MCNAUGHTEN, HAROLD PLAISTED, L. S. RANDOLPH, A. B. ROPES, J. E. SAGUE, J. E. STEWARD, F. W. TAYLOR, J. W. WARRINGTON and E. N. WRIGHT.

The degree of Doctor of Philosophy has been conferred on DR. THOMAS B. STILLMAN. The honorary degree of Doctor of Engineering on E. D. LEAVITT, JR., M. E., President of the Society of Mechanical Engineers.

MEYERS C. CONWELL City Engineer of Wilmington, Del., resigned his position on June 12 to take effect July 1, to accept that of Chief Engineer of the new railroad about to be built in the United States of Colombia from Puerto Berrio to Medellin. The road is to be about 125 miles long, and he will probably take with him three or four assistants. Mr. CONWELL proposes to leave for Antioquia, United States of Colombia, about July 1.

Mr. CONWELL came to Wilmington from the lower part of the State, where he had been employed on the Junction and Breakwater Railroad, about twelve years ago, and after serving as assistant to Chief Engineer Daniel Farra, was elected to the position he has so ably filled since 1874.

THE CONVERSAZIONE OF THE INSTITUTION OF CIVIL ENGINEERS.—On Wednesday evening, the 30th ult., Mr. JAMES BRUNLEES, the President of the Institution of Civil Engineers, and Mrs. BRUNLEES, held a most successful conversazione at the South Kensington Museum, London, Eng. The number of guests was about 2,500, the various branches of science and literature being well represented.

During the past twelve months there has been an increase in the Institution of Civil Engineers of 1 honorary member, 51 members, 172 associate members and 40 students, with a decrease of 10 associates, making an aggregate gain of 254 and bringing up the total to 4,400 of all classes, or an addition in the year at the rate of more than 6 per cent.

AT the last meeting of the American Society of Civil Engineers, held on the 6th, the following were elected: *For Members*—AUGUSTUS P. CLARKE, Civil Engineer, Cazenovia, N. Y.; JOHN WILLIAM KENDRICK, Engineer in Charge of Construction, Minneapolis & Sauk Rapids Division Northern Pacific R. R., Minneapolis, Minn.; HENRY COATHUPE MAIS, Engineer in Chief for the Colony of South Australia, Adelaide, South Australia; ALBERT BRAINERD ROGERS, Engineer Mountain Division Canada Pacific Railway, Selkirk Range British Columbia; ALONZO J. TULLOCK, Engineer and Superintendent Missouri Valley Bridge and Iron Works, Leavenworth, Kan. *For Juniors*—ALBERT NEUMANN CONNETT, Civil Engineer, South Orange, N. J.; PRESTON KING YATES, Civil Engineer, Canajoharie, N. Y.

At the graduating exercises of Columbia College, held in the Academy of Music on Wednesday, the following degrees were conferred:

The degree of Bachelor of Science was conferred on J. T. J. BIRD and H. L. SATTERLEE.

The degree of Engineer of Mines was conferred on G. H. ABEEL, RANDOLPH ADAMS, S. W. BALCH, JOHN H. BANKS, A. F. BARDWELL, V. M. BRASCHI, Ph. B., JOHN P. CHANNING, GEORGE ENDICOTT, J. C. FERRIS, D. F. HAASIS, W. S. HUMBERT, A. W. LILLIENDAHL, JOHN J. MACTEERNE, ROBERT PEELE, JR., F. POWELL, A.B., J. M. RICH, J. C. RICHARDSON, T. W. RIDSDALE, G. A. SUTER, A. E. TOWER, A. L. WALKER, W. H. WEED, A. F. EMRICH.

The degree of Civil Engineer was conferred on T. J. BRERETON, A. B., J. M. CARRERE, C. F. FERRER, E. C. FLALLOS, C. F. PARRAGA, G. RENAULT, G. A. TIBBALS and A. E. MESA.

ELECTIONS AND APPOINTMENTS.

DETROIT, LANSING & NORTHERN.—General Manager MULLIKEN has issued circulars announcing the following facts:

The property and franchise of the Chicago, Saginaw & Canada Railroad Company, recently sold under foreclosure, having been purchased by the Detroit, Lansing & Northern Railroad Company, notice is hereby given that the latter company will assume the control and management of the property on the 10th inst., after which date it will be operated as a portion of the Detroit, Lansing & Northern system and in charge of the following officers:

T. M. FISH, General Superintendent, office at Ionia, Mich.

J. J. MCVEAN, heretofore Engineer of the D. L. & N. R. R., is promoted to the rank of Chief Engineer, with authority extending over the Chicago, Saginaw & Canada and Saginaw Valley & St. Louis roads.

JOHN DOYLE, Roadmaster, is promoted to the rank of General Roadmaster, with authority as above.

N. W. MERRILL, Superintendent Saginaw Valley & St. Louis Railroad, will also have charge of and be held responsible for the operation of the Chicago, Saginaw & Canada division.

The road bought is 40 miles long.

IMPORTANT PATENT DECISION.

THE BARBED WIRE FENCE CONTROVERSY DECIDED AGAINST THE MONOPOLY.

ST. LOUIS, June 4.—Judge Treat, in the United States Circuit Court, to-day rendered a decision of great importance to nearly every part of the United States, settling the great barbed wire fence controversy. The Court holds that the patents issued to Kelly & Glidden are void, and therefore refused to grant the preliminary injunction asked for by the Washburn & Moen Manufacturing Company and Isaac L. Ellwood. The Washburn Company likewise sought an injunction against Gustav Griesche and Henry Fuchs relative to the manufacture of patent machines for barbed wire. This injunction was refused, on the ground that that there was no infringement. The earliest barbed wire patent was issued in 1867 to one Hunt, since which time the issues and reissues have been almost innumerable. All of these, or at least all of them that possessed practical business features, have been from time to time acquired by the Washburn & Moen Manufacturing Company, of Worcester, Mass., and Isaac L. Elwood, of De Kalb, Ill., the plaintiffs in the cases referred to. Of all the numerous patents the only practical ones are those known as the Kelly & Glidden patents, the original issue of which has been claimed by the defendants in the suits, enlarged and amplified out of all knowledge by subsequent reissues. It is precisely here that the controversy takes place and where the battle has been fought out. If the issues are declared to be within the meaning and intention of the original patents, or if they are, in other words, valid, the defendants here will have been guilty of infringement. If otherwise, and the courts should declare the reissues vitally at variance with the original patents and invalid, the business of manufacturing barbed wire will be thrown open without restriction.

About two years ago, by a decision of the United States Court in Chicago, the Washburn & Moen Company was given the sole control of all barbed wire fencing made in the United States under a reissue of the Glidden patent, which included every sharp-pointed metal or wire fence for the purpose of inflicting wounds upon animals and

preventing them passing the line of a fence. By this decision the Washburn & Moen Company, who are assignees of Glidden's patent, acquired what is known among dealers in barbed wire fences as the "broad claim"—a complete monopoly of barbed wire fences. Licenses were issued to other companies, permitting them to manufacture and to vend the fences, under condition that they would pay a royalty on all wire sold and would not sell lower than at a fixed price. Thus the company and their licensees, having a monopoly, were enabled to fix prices at figures which yielded them princely revenues, the royalties alone amounting to between $1,500,000 and $2,000,000 a year.

Subsequent to the decisions in Chicago in the Haish and similar cases the Supreme Court of the United States rendered two decisions which appeared to entirely overturn the basis on which the Chicago case rested. These decisions were on entirely different subjects, but went to the principle of the right to embody in a reissue of a patent matter not expressly claimed in the original. This set the defendant in the present cases on inquiry, and the result was the establishment, both in St. Louis and in Iowa, of factories for the production of barbed wire. Suit was instituted, first against the Iowa defendants, and an injunction asked for to restrain them from further operations. These cases were argued last winter at Keokuk before Circuit Judge McCrary and District Judge Love. The decision was reserved. Subsequently eight suits were brought against the St. Louis defendants—namely, three against the Simmons Hardware Company, two against Fuchs, two against Gates and one against Griesche. These are the cases just decided. The subordinate question of the validity of the patents on the machines is decided against the great monopoly. The effect of this decision is to release all restrictions on the manufacture of barbed wire, and save millions of dollars annually to the farmers and ranchmen of the country that has heretofore been paid in the shape of royalty.

There were, according to the estimates of the best qualified judges, nearly 80,000 tons of barbed wire manufactured in the United States in 1882, or a total length of about 500,000 miles of wire. Upon this the firms claiming under their patents the exclusive right to manufacture barbed wire made within the year in royalties from their licenses and from extra profits in their own business between $4,000,000 and $5,000,000.

THE AMERICAN INSTITUTE OF MINING ENGINEERS—VIRGINIA MEETING.

For weeks past the announcement that the summer meeting of the American Institute of Mining Engineers would be held at Roanoke, Va., gave rise to a pleasant anticipation in the minds of those who contemplated attending, and the proceedings during the week of the meeting fully realized all expectations. The pleasant features of the meeting were too numerous to receive mention here, and we will therefore simply confine ourselves to a brief outline of the events of the week.

The opening session was held in the Hotel Roanoke, on the evening of June 4, and addresses of welcome were delivered by Messrs. J. D. Austin and Lucien H. Cooke, Mayor of Roanoke. The remarks of these gentlemen, as well as those of Major S. Griffin, who welcomed the members on behalf of the State of Virginia, as he stated, were calculated to fully dispel all doubts—if, indeed, there existed any—in the minds of the visitors as to the hospitality and hearty welcome that awaited them. An appropriate response was made by President Hunt, who then delivered his inaugural address. The first paper of the evening was that of Mr. A. S. McCreath, of Harrisburgh, Pa., on "The Iron Ores of the Valley of Virginia," being an interesting collection of data as to the mineral resources of that special section of the State. After the completion of this paper President Hunt announced that all discussion would be postponed until after the reading of the paper on "The Ores of Cripple Creek, Va.," by Capt. C. R. Boyd, of Wytheville, Va. Both papers were of considerable length, and, taking into consideration the various other proceedings of the evening, the time remaining for discussion was therefore very limited; so much so, in fact, that few, if any, points worthy of special notice were touched, and the meeting adjourned at about 10:30.

Tuesday was devoted to excursions, and accordingly the members started on a special train at 8 a. m. and reached Lynchburg in about two hours. The furnace of the Lynchburg Iron Company was here inspected, after which a train provided by the Richmond & Allegheny Railroad Company took the visitors to the Riverville iron ore mines on the lower James River. Returning from the mines, the guests found a collation served at the depot, which was duly appreciated. Owing to a breakdown of the engine on the return trip the train did not arrive at Lynchburg at the appointed hour, and the afternoon session that had been provided for on the programme was consequently omitted. Having arrived at Lynchburg the members repaired to the Chamber of Commerce Hall, where a collection of minerals was exhibited, after the inspection of which the train for Roanoke was taken.

Wednesday morning found the members assembled in Rorer Hall, Roanoke, for the reading and discussion of papers. The first paper read was that of Major Jed Hotchkiss, of Staunton, Va., being virtually made up of two papers—one on "The Coals of the Lower Measures or Conglomerate Group in the Virginias," and another on "The Iron Ores of the Virginias West of the Archean or Eastern Blue Ridge." By the aid of a map Major Hotchkiss briefly gave an outline of the mineral wealth of the country, showing the location of the iron ores, coal fields, etc. Owing to lack of time, it was found that the excursions which had been proposed for the morning—namely, visits to the Crozer Furnace, the Rorer Iron Co.'s mines and the Roanoke Machine Works—would conflict with the session, and it was consequently proposed that those members who should prefer them to the session should leave during its earlier part. The invitation, it may be needless to say, was eagerly responded to by a large number. Following Major Hotchkiss was a paper on "Cast Iron of Unusual Strength," by Mr. Edward Gridley of Wassaic, N. Y.; another by Dr. P. Frazer, on "Copper in Pennsylvania;" one by Mr. F. P. Dewey on "The Porosity and Specific Gravity of Coke," and still another by Mr. E. G. Spilsbury on "The Designolle Process." Later in the afternoon a special train on the Norfolk & Western road, carrying the members and invited guests, left Roanoke for Blue Ridge Springs, whence, after having been relieved of part of its burden, it proceeded to the Houston and Upland ore mines.

At the evening session, which was held after a banquet served by the citizens of Roanoke, Mr. J. P. Witherow, of Pittsburgh, read a paper on "The New Blast Furnace of the Crozer Steel & Iron Co." This was followed by a paper on "The Geological Position of the Philadelphia Gneisses," by Prof. C. H. Hitchcock, of Hanover N. H. The deaths of two former members of the Institute, Gruner, of Paris, and Mr. James Park, Jr., of Pittsburgh, were then duly taken notice of, after which, in view of the fact that this would be the last session of the Institute, the secretary read the names of the newly-elected members and the titles of the remaining papers announced for this meeting. These were: "Repairs and Improvements at Cedar Point Furnace, Port Henry, N. Y.," by Mr. T. F. Witherbee, of Port Henry; "Recent Improvements in the Metallurgy of Zinc," "Leaching of Gold and Silver Ores in the West," and "The Appolt Oven for Coking Coal," all by Dr. T. Egleston; "The Schwartzkoppf Control and Safety Apparatus for Steam Boilers," by C. A. Stetefeldt, of New York City; "The Shelf Dry Kiln," by the same gentleman; "The Coals of Pocohontas, Virginia," by Capt. C. R. Boyd; "The Treatment of Slimes," by Mr. F. G. Coggin, of Lake Linden, Mich.; "Boiler and Boiler Settings for Blast Furnaces," by Mr. F. W. Gordon of Pittsburgh, Pa.; "The Timber of West Virginia," by Prof. S. P. Sharples, of Boston, Mass.; "Notes on the Geology of Alabama," communicated by Dr. R. W. Raymond, of New York City; "The Langdon Gas Producer," by Mr. M. N. Langdon, of Chester, N. J., and "Determination of Manganese," by Mr. Magnus Troilius, of Philadelphia, Pa. In addition to these the following papers not given in the programme were read by title: "On the Volumetric Determination of Manganese," by Messrs. Beebe, Colby and Mackintosh, of New York; "Russell's Improved Process of Lixiviating Silver Ores," by Mr. C. A. Stetefeldt; "On the Copper Rocks of South Mountain," by Mr. C. H. Henderson, of Philadelphia; "On the Iron Ores of Eastern United States and their Geological Horizons," by Prof. J. C. Smock, of New Brunswick, and "Notes on the Construction of Chimneys," by Mr. P. Barnes, of Elgin, Ill. Resolutions of thanks were also passed to the citizens and ladies of Lynchburg and Roanoke; the Shenandoah Railroad, the Norfolk & Western, the Richmond & Allegheny Road and all other individuals and corporations to whom the Institute was indebted.

On Thursday the members left Roanoke for Pocahontas, visiting the Southwest Virginia Improvement Co.'s coal mines and coke ovens. The Ripplemeade ore mines and the Bertha Zinc Works were also included in the programme, the members stopping at Wytheville for the night. Wytheville was left early Friday morning for the Cranberry Mines' magnetic ore fields, the party returning to Roanoke at a late hour of the night. Saturday morning found the greater number of the visitors assembled at the Roanoke depot waiting for the train that would bear them to their respectives homes, and all were unanimous in their expressions of pleasure and satisfaction at the various proceedings of the week.—*Mechanics.*

THE CIVIL ENGINEER AS AN OFFICE-HOLDER.

The Texas railway law, as passed in April last provides for the appointment by the Governor of an experienced railway engineer, whose duty it shall be to carefully inspect the condition and manner of operating railways in the State with special reference to the safety and the proper accommodation of the public.

This is a good sign in the regulating business. In many of the States when laws of this character have been enacted the civil engineer has been carefully excluded from the appointments of commissioners upon whom the duty of regulating the railways was to devolve. Because he builds the roads he is looked upon as a pensioner upon the system; as disqualified for holding such an office as railway commissioner because he earns his daily bread in the development of a system to which all classes of people owe so much. The civil engineer as a rule attends strictly to his duties. He is rarely a politician and seldom a capitalist. While holding important positions of trust, controlling great expenditures both for labor and material, receiving only a monthly stipend, never a percentage upon his work as architects do, he bears a reputation for honesty second to none of those who obtain a livelihood in other professions or callings. If there is the least taint of dishonesty attached to the individual engineer he is perforce compelled to abandon his calling and seek other means of obtaining a livelihood; otherwise he must starve. As a class, engineers are able and reliable, and their education and experience make them fit persons for appointment by the State to the oversight of its railway system.

The State of New York has employed a civil engineer to look after its canal and railway interests ever since these routes for transportation were built. The contributions of technical knowledge which the various engineers holding this position have given to the world are not only a credit to the State and to the profession, but they constitute no small portion of the text-books used in schools wherein the young engineer of to-day is acquiring his knowledge. It is a marked characteristic of the civil engineer to serve his employer to the best of his ability. There is nothing in his calling which would prevent him serving the State as faithfully and well as he would the capitalist or the railway corporation. It certainly is a prejudice which would exclude him from a political appointment that involves business contact with railways. A lawyer is always considered an eligible candidate for all offices and honors that a State or government can bestow. Perhaps there would be less warfare between the people and the railways if the champions of the fight upon both sides were not altogether lawyers.—*Railway Age.*

NEWS OF THE WEEK.

FARGO SOUTHERN RAILROAD CONTRACTS.—Senator J. J. Patterson of Washington has arrived in Fargo to take on contracts for building the above road to Worthington, Minn.

BRIDGE BONDS TO THE AMOUNT OF $75,000 have been issued by the city of Grand Forks, D. T.

AN ENGINEER capable of laying out the grounds of the new capitol at Bismarck is being sought in Chicago. The city of Pullman, Dak., is also to be laid out.

THE ST. PAUL Council Committee on Railroads have been considering the plans of Engineer White of the Milwaukee & St. Paul Company for a tunnel under the tracks across Washington Avenue South. The estimated cost of tunneling and erection of suitable iron posts and girders at Eighth Avenue is about $100,000.

THE FLORIDA SHIP CANAL.—A meeting of the Florida Ship Canal and Transit Company was held last week, presided over by the Hon. John C. Brown, of Tennessee. Encouraging reports were made by the various committees. Gen. Charles P. Stone, Chief Engineer, stated that he had examined fully into the reports of previous engineers, and entertained no doubt of the possibility of constructing a tide-water ship canal across the peninsula of Florida. He also stated that his assistant engineer, A. F. Hill, is already on the ground in Florida, and that the actual work of survey will begin immediately. The survey will be completed in about six weeks, and as soon as the exact route of the canal is determined upon contracts will be let and the work will be pushed with all possible vigor. It is thought the work will begin by September next.

A CATFISH CAUSES TROUBLE.—ROCK ISLAND, Ill., June 8.—For several days the Rock Island waterworks have been practically useless. The authorities telegraphed to Ira Holly, whose system is in use here, and he came yesterday. Having concluded an examination, he made a special report to the City Council this evening. He found that the pumps were working with power which should produce 27,000,000 gallons per day, but the city as only getting about 6,000,000 gallons. Taking

the pumps apart he found in them a catfish 3 feet 9 inches long and weighing 50 pounds. Upon removing the fish, which had to be done in sections, the pumps worked all right.

THE IMPROVEMENTS IN GALVESTON BAY were lately inspected by several engineers. Fobes & Co. have completed the contract they had with the government to deepen the ship channel from Bolivar to Morgan Cut. Col. Anderson was the engineer in charge. The dredge averages 2,500 yards a month.

NEW RAILROADS.—The Wadena & Park Rapids Railway Co. has been incorporated at Minneapolis. The capital is $1,000,000.

THE INTERSTATE TELEPHONE AND TELEGRAPH Co. has been incorporated in Chicago. The capital is $500,000. It is intended to begin work in Chicago. It is stated that the company is formed for the introduction of the Hopkins telephone, for which great things are claimed. Among other points of excellence, it is stated that communication over it can be successfully carried on 480 miles apart, and that conversation has been had between Chicago and New York. A special feature of the telephone is that it uses an intermittent instead of an unbroken electric current, and for this system great advantages are claimed.

THE NORTHAMPTON (MASS.) WATER WORKS will have a reservoir holding 16,000,000 gallons, or four times as much as present reservoir.

THE WESTINGHOUSE AIR-BRAKE CO. has just paid 30 per cent. as a semi-annual dividend, and there is to be another special dividend in a few months from the English business.

THE BLOOMINGTON & BEDFORD ROAD is to make three surveys for an eastern outlet—one to Columbus, another to Seymour and a third to Madison, Ind. The road selected will depend on the advantages offered.

THE ENGINEERING CORPS OF THE SUNSET ROAD are near Camp San Saba. Mr. J. Hennermann, the engineer in charge, is making a preliminary survey for an extension from San Antonio to the San Saba valley.

THE PROPOSED DAM AND BRIDGE at East Hampton (Mass.) have been inspected by engineers, but it is doubtful whether the Council will vote the additional $5,000 which the contractor requires.

SOME 600 MILES OF ROAD in Guatemala are being worked up by Gen. Butterfield. The total cost is estimated at $8,000,000.

LAND SLIDES have been very frequent on the Northern Pacific during the past season. Some forty miles of a new road-bed will have to be built.

WARREN BRIDGE (BOSTON) is to be widened and also Warren avenue. The expense is calculated at $70,721.

MALDEN (MASS.) is to have Pleasant street and Central square widened. Mr. A. F. Sargent, the city engineer, exhibited plans. The total cost will be $75,000, and there is some opposition to the improvement.

THE RIO GRANDE BRIDGE will not be begun by Gould until the summer rise has subsided.

THE TEMPLE (TEXAS) WATER-WORKS will be immediately begun.

A RUSSIAN CONTRACT IN PROSPECT.—Writing from Baku, on the Caspian, the seat of the Russian oil industry, on the 5th ult., the correspondent of the *Daily News* says: "Now that I am on the subject of pipes, I may mention that a nice little contract awaits some iron-master in England or Belgium. The principal oil-master in Oleopolis (Baku) is asking the Russian government for permission —which, no doubt, he will obtain—to lay down lines of pipes all the way from Baku, on the Caspian, to Batoum, on the Black Sea, a distance of some 460 miles. . . . This particular oil-master, a Swiss gentleman, is proprietor of about forty springs."

CEMENT.—The old-established brick and cement business of Messrs. J. B. White & Brothers, England, is to be turned into a limited company, with a capital of £1,000,000, in £10 shares, of which 30,000 are 6 per cent. preference shares and 70,000 ordinary shares.

HOLYOKE (MASS.), will replace the old bridge at Appleton street by a new one.

THE SURVEYORS OF THE WAUKESHA, MUKWANAGO & GENEVA LAKE RAILROAD have begun work. Two routes are to be surveyed, of which one will leave the line of the Northwestern and the St. Paul at about the point where they diverge, three or four miles southwest of Waukesha, and passing near Johnson's stone quarry in Geneva, cross the Saylesville pond and thence run southerly through Mukwanago, from which point it will go almost directly south for a few miles, and then southwest through a natural valley to Geneva. The other route begins just west of the State industrial school grounds runs near Fox River on the east side through the town of Vernon, and approaches Mukwanago at about the same point as the other. The latter line would be the shortest between Mukwanago and Waukesha, but the former would require less new road to be built, if, as is proposed, an arrangement can be made with the St. Paul or Northwestern to connect with one of those roads at the junction first spoken of.

NORTHFIELD (MINN.) HAS A BRIDGE that is sometimes overloaded, and the bridge examiner has stated that it is liable to go down. The mayor, however, has simply decided to try and prevent overloading.

THE MINNEAPOLIS WATER-WORKS EXTENSION will take $280,000—the full sum voted by the Legislature.

THE TEXAS & PACIFIC RAILROAD has reduced the number of its laborers, owing to the dull times.

A MILWAUKEE & ST. PAUL EXTENSION from Mather to Black River Falls is spoken of.

THE CANADIAN PACIFIC is having some trouble with its employés. It is now operating 1,225 miles of road to Medicine Hat, 660 miles west of Winnipeg.

THE OMAHA & NORTHERN RAILROAD has been incorporated. It will run from Omaha to the north line of Cedar County opposite Yankton in Dakota, a distance of 130 miles, with a branch of 80 miles northwest to Stanton. The capital is $2,000,000. Surveys and work will be begun at once.

THE MICHIGAN TELEPHONE COMPANY has been incorporated at Detroit. It takes the place of the Michigan Bell telephone and the Detroit companies. The capital is $2,500,000.

THE MAYOR OF ST. PAUL (MINN.) estimates its present population at 90,000.

THE ENGINEERS OF THE ST. CLOUD, MANKATO & AUSTIN RAILROAD have gone into camp opposite Mankato, and will begin the final survey. The corps is in charge of O. D. Brown.

THE CANADIAN PACIFIC CONTRACTORS.—The Toronto *Globe* charges Alexander Manning, Peter McLaren, James Shields and J. J. McDonald, contractors on section B of the Canadian Pacific, with spending vast sums of money in aid of government candidates at recent Dominion elections, and asserts that they were recompensed by the government for these advances by allowing a remeasurement and reclassification of the work, which gave an increase of $300,000 to the contractors. The *Globe* makes other charges of crookedness against the contractors, and calls upon the governor-general to appoint a royal commission to investigate the frauds.

AT THE LAST MEETING OF THE MINNEAPOLIS WATER BOARD, Engineer Waters submitted a plan of a duplex system of pipes for the central division. The pipes furnishing water to the city streets are entirely independent of the pipes furnishing water to the avenues. The street pipes cross the avenue pipes at all of their intersections, furnishing water at almost every crossing from two distinct sets. The territory covered by Mr. Waters' plan will require pipes sufficient to furnish 30,000,000 of gallons, and the amount required for the whole city cannot be estimated if the present rate of consumption continues. The engineer requested a statement from the board as to the amount of water to be provided for domestic purposes, his estimate for fire purposes per day being 6,000,000 gallons. To supply this amount would require a pipe twenty inches in diameter, and it must be provided for over and above the amount considered necessary for domestic purposes. Referred to the committee on construction.

CHIEF ENGINEER BLUNT, OF THE WINONA & ST. PETER, has returned from Dakota. He states that track-laying on the Iroquois branch is progressing rapidly, and is now laid to within twenty miles of Howarden, Iowa. The track-layers are now coming west at the rate of a mile a day. At Iroquois two miles of the track will be laid as soon as the bridge, now building, is completed. The whole distance, 128 miles, it is expected, will be completed by October 1. This will place Southern Dakota in direct communication with the coal fields of Iowa, and open a new line for the Northwestern from Chicago to Dakota.

THE LOCOMOTIVE WORKS throughout the country seem fairly busy. The Baldwin Locomotive Works at Philadelphia already have a full half of their capacity engaged for 1883. They are running their usual force of 3,000 hands, and have no present intention of reducing the number. The Portland Machine Company, of Portland, Me., has enough locomotive work on hand to occupy them until November. The three locomotive works at Paterson, N. J., are employing 6,160 men. The Rogers Company employ 4,700 of this number; the Grant Company 760 men, and turn out an engine every other day. The Cooke, formerly the Danforth, works, employ 700 men, and have over seven months' orders on hands.

THE ATCHAFALYA BRIDGE will be finished, it is thought, in ninety days.

THE SEDGWICK & WESTERN RAILROAD has been chartered at Topeka, Kansas. The line is to run from Sedgwick City, in Harvey Co., to Dodge City, in Ford Co. The capital is $3,500,000.

BOUND TO BEAT THE TELEGRAPH CO.—A man, a little top-heavy, rushed into a Sixth avenue telegraph office, this city, seized a telegraph blank and stub pen with a ball of dried ink on the end, and by propping himself against the counter, managed to write the following:

"Kate, I won't be home till morning.

"HARRY."

"What'll that cost?" said the man, handing the message through the port hole to the manipulator of electricity.

"Let me see. Seven words—fifteen cents. Anything not exceeding ten will cost you fifteen cents to any addresss in the city," answered the operator.

"I'm bound to have the worth of my money out of you corporations, then," said the man, bracing himself against the counter as he traced on a blank this clear messsage:

Incomprehensibility, manufacturers, transcendentalism, Constantinople, concavo-convex, Massachusetts, assassination, Pennsylvania, imperturbability, philoprogenitiveness."

"There, string that on your wire and send her at a 2:40 rate," said the man with a look of vengeance in his eye.

The operator counted the words, but volunteered the information that there was no sense in the message.

"I know there's no sense in it, but Kate'll understand it all the same; she'll know I'm on a drunk anyway when I send a message at this hour, whether it's sense or not. I make 'em long on purpose to break the back of your darned machine. Shovel 'em in and start the crank. I'm in for a good time. Never mind the expense; here's your fifteen cents." And the man ran out and hailed a passing cab.—*Ex.*

SALE OF BRIDGE BONDS.—The Mayor and Comptroller of Brooklyn sold on Wednesday $656,000 of four per cent. bridge bonds, payable July 1, 1923, at the following figures: $156,000 at $111.39; $100,000 at $108.50, and $100,000 at $105.52.

THE PETERSBURG (VA.) CITY ENGINEER.—The ordinance creating the office of City Engineer fixes the salary of that officer at $1,200 per annum, payable monthly. Applicants for the position must be residents of the State, and must hold certificates of proficiency from the Board of Examining Engineers. The board has been appointed, and consists of Colonel W. E. Cutshaw, of Richmond; Major William Hunter, of Lynchburg, and Lieutenant J. T. Townsend, United States Engineer, residing in Petersburg. The board will meet in Petersburg to examine applicants, and on the 1st of July the council will proceed to the election of a city engineer. The term of office of the engineer is twelve months, and he is eligible and subject to re-election as long as he shall give satisfaction. The day of meeting of the board has not yet been fixed.

[We wonder if all this tomfoolery is gone through with for the appointment of the City Attorney, or for any other little $1,200 office. The successful applicant ought to be proud after having been passed upon by so warlike a board of examiners as the above. Now let New York, Philadelphia and other similar insignificant cities take a lesson in selecting a fitting man to build its streets, etc.]

CHICAGO, MILWAUKEE & ST. PAUL.—It is contemplated to built a branch between Mitchell and Aberdeen, Dak. Work will be begun immediately and 75 miles finished this season. It is rumored that the extensions in Wisconsin and Illinois have not been decided on, and a prominent officer thinks that there may be no more construction work whatever this season.

THE MEXICAN NATIONAL ROAD in Michoacan is in trouble, and it is proposed to transfer the concession to another company for the construction of a railway from Patzcuaro to a point on the Mexican Central.

THE PANAMA CANAL.—M. Jules Dingler, the recently appointed chief of works of the canal company, has returned to France. He says he will be back in three months. Captain Richler, of the French navy, is to take his place.

THE JAMES RIVER (VA.) MINES are being examined by the American Institute of Mining Engineers, and already contracts have been made for ores by some of the engineers.

THE ORIENTAL RAILROAD (MEXICO).—It is stated that Gould has made arrangements for the construction of this road.

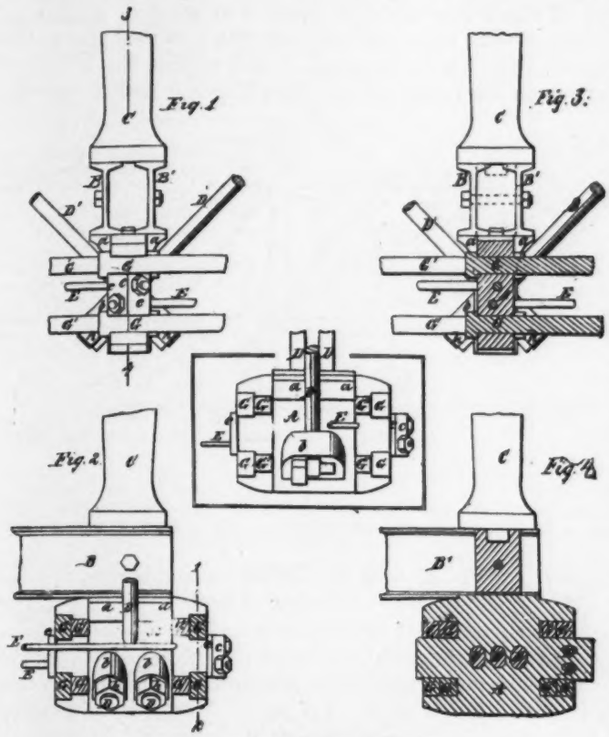
SUIT FOR BREACH OF CONTRACT.—B. J. McGrann, who built the Pittsburgh and Lake Erie road in 1879, has entered a suit for balance claimed for $518,000. The company enters a cross-suit for $500,000 for imperfections in work; they also claim to hold his receipt in full.

NEW ROAD—THE PITTSBURG & NEVILLE RAILROAD.—A charter has been issued to this company. The line is to run from Neville to a point in Stowe township, Allegheny County. Capital, $200,000.

THE MEXICAN GOVERNMENT has authorized the construction of a road from Apizaco to Huachinango.

TRUSS BRIDGES.

Francis P. Lowthorp, March 13, 1860, patented another improvement in bridge-trusses, the present invention consisting of a "combination plate," with open slots adapted



LOWTHORP'S TRUSS BRIDGE.

to receive the enlarged ends of the lower chords and the vertical and diagonal posts and braces of a truss frame.

Its object is stated to facilitate the erection of the bridge and to obtain a secure attachment without recourse to the expensive forging work generally employed on bridges then constructed.

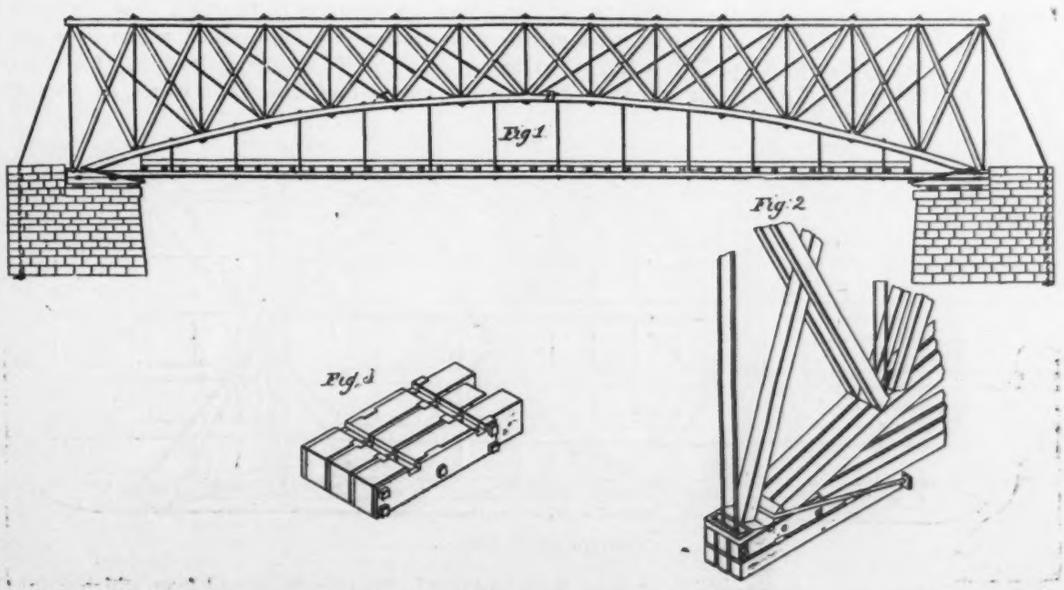
Fig. 1 shows a side view; Fig. 2, a transverse section; Fig. 3, a section on line 12 of Fig. 2; Fig. 4, a section on line 34 of Fig. 1, and Fig. 5 a plan view. *A* is one of the combination plates, and *B B'* the ends of two floor beams resting on the legs *a* of the post *O*. *D D'* are the diagonals and *E* the horizontal braces. *G G'* are the lower chords of the truss. The diagonals pass directly through openings in the body of the combination plate, and are secured by nuts *h*. The horizontal rods pass through inclined openings in the plates, and are similarly secured. The lower chord rods *G G'* have enlargements, or T-heads, at their ends. Slots are formed in the opposite ends of the two adjacent chord rods, which are connected to the plate by simply sliding them laterally into the slots. Small lips *e e* (Fig. 2) cast on the opposite ends of the plate serve to retain the ends of the rods in their proper position within the slots. This manner of fastening the lower chords, Lowthorp believes to be much superior to the ordinary riveted link attachment, such as is used in the Whipple bridge.

The nature of Goodwin O. Bishop's improvement in bridge trusses (April 24, 1860) consists (1) in the construction of a peculiar shoe, and the mode of securing it to the bottom chord; (2) the arrangements of the bottom arch, top chord, braces, angle blocks, tension rods and angle rods, when combined as a whole to form a compound truss. By this arrangement, it is asserted, the camber of the bridge may be adjusted at any point, and the counter-braces sustained against the shock of a moving train, or other heavy body passing over the bridge.

Fig. 3 shows the step having plates of metal, with projecting ribs, which are fitted firmly on the sides and between the timbers, forming the bottom chords which span the distance between piers. On the top of the step are sunken grooves, into which projecting pieces on the underside of the shoe are fitted. The shoe is made of cast iron, and forms the step and bearing of the arch chord and main brace, and is held in place by rods forming a stirrup, as seen in Fig. 2.

The advantages of this compound arch truss are said to consist in dispensing with the king-post, so that there is no halving or locking of the timbers in any place, thereby obviating the use of extra heavy timbers for railroad bridges.

The bottom chord or stretch extends horizontally from pier to pier, to both ends of which are secured the shoe described. This shoe supports the arch chord above. Both the top and arch chords are brought to bear upon the braces by tension and angle rods radiating from the center of the arch chord, whereby the camber of the bridge may be ad-



BISHOP'S TRUSS.

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justed at any or all of the points or bearings. The bottom chord is supported by vertical rods extending down from the arch chord.

J. P. Fisher embodies in his construction, June 26, 1860, the truss and suspension methods of bridge building. He says that these methods he has advantageously combined so as to present great strength and stiffness.

A are the sections of the lower chord of the truss, which form the sides of the bridge. They are of cast iron. *C* are the sections of the top chord. These sections fit over the tops of the posts *B*, which are cast with a wrought iron rod running vertically through them, which projects from their ends and upon which are placed end nuts. The lower projecting parts of these rods are fitted with a plate large enough to lap some distance under the bottom of the segments *A*. On the top of each post a cast iron saddle is fitted over the top chord. Nuts are used to hold the parts of the truss together vertically, and they are held together longitudinally or horizontally by dovetails on the posts.

The parts are further secured by oblique tension braces of wire rope, of which there are four to each panel, two of which are connected to each post by passing through eyes therein. The four tension braces of each panel are connected by a screw-swivel device. By turning the screw all four braces are tightened up together, and a uniform strain is brought upon each one Besides these braces there are oblique braces of wrought or cast iron applied between the posts and the top chord to stiffen the latter in every panel of the truss. *G G* are the transverse girders which support the floor, and are of iron, and fitted to the chord sections at the center of each panel.

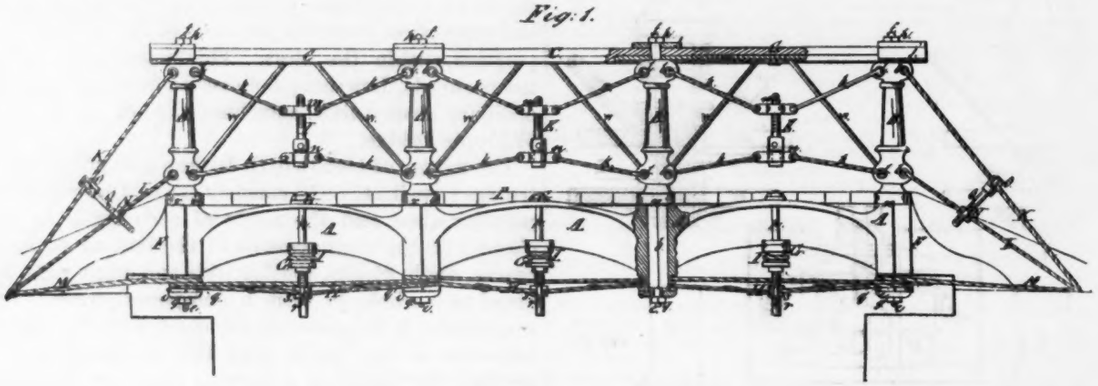
H H are tension braces applied to the truss frame under each panel of the lower chord, consisting of one or more lengths of wire rope passed back and forth around two adjacent posts. The downwardly projecting extremities of the sections *A* are grooved to receive the rope and prevent its slipping out of place. A screw-lever is inserted between this tension rope. By using the screw as a lever, the two parts of the tension rope may be twisted one or more times around each other, which has the effect of drawing the lower parts of the sections very tightly together. *I I* are tension braces also of wire rope, which are applied to the floor girders by passing around their ends and extending across the length thereof. The braces are applied and adjusted in the same manner as the braces *H*. *J J* are diagonal braces, like the braces *H* and *I*. *K L M* are double tension braces, applied at different elevations to each end of each truss frame, and are similarly adjusted in the manner of the other braces.

B represents the wooden chords placed side by side and about two inches apart. They rest at their opposite ends on corbels *W*. A straining rod *E* passes between the chords, and through the shoe *F*, where it is secured by nuts *P*. The arch *C* is formed by sections of wood *A A*, held between cap *t* and angle block *m*; *N* are the main and counter braces; *Q* are wrought-iron rods combining and holding firmly the chords, arches and braces.

In Fig. 2, *c* are wrought-iron stirrups extending across from center to center of chords *B*, where the ends are then secured by nuts. Within the angles of these stirrups rest the heels of braces *H H*, the tops of which ascend and meet over the iron stringer bearers *D*, where they are secured by iron plates 12. These string bearers *D* are about $\frac{1}{2}'' \times 4''$, slightly notched on their lower edges, as seen at *k k*, where they rest in the chords *B*, and from which point they gradually converge, externally forming the *V* (Fig. 4) with an eye formed in the end for the reception of the straining brace rods *a*. Connecting rod *c* passes through the tops of arches and eyes 8 of straining rods *a*, where they are secured by nuts.

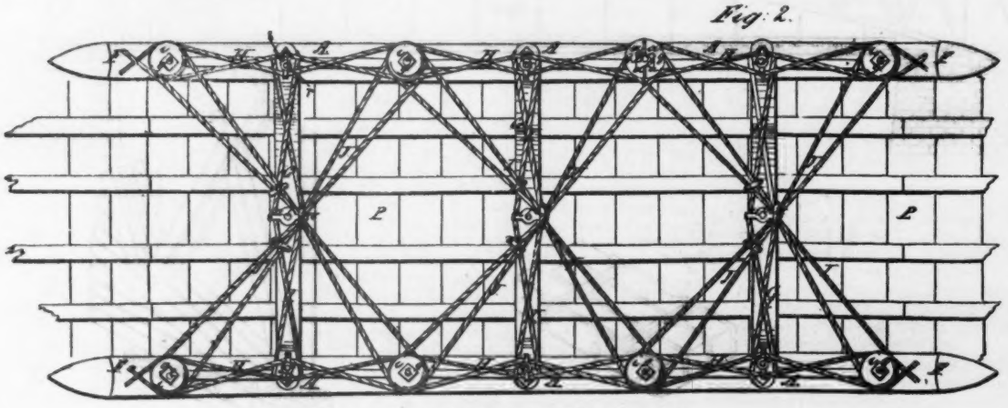
Figs. 1, 2 and 3 illustrate Ephraim J. Story's truss bridge, for which he received a patent Feb. 12, 1861.

Fig. 1.



FISHER'S TRUSS.

Fig. 2.



FISHER'S TRUSS BRIDGE.